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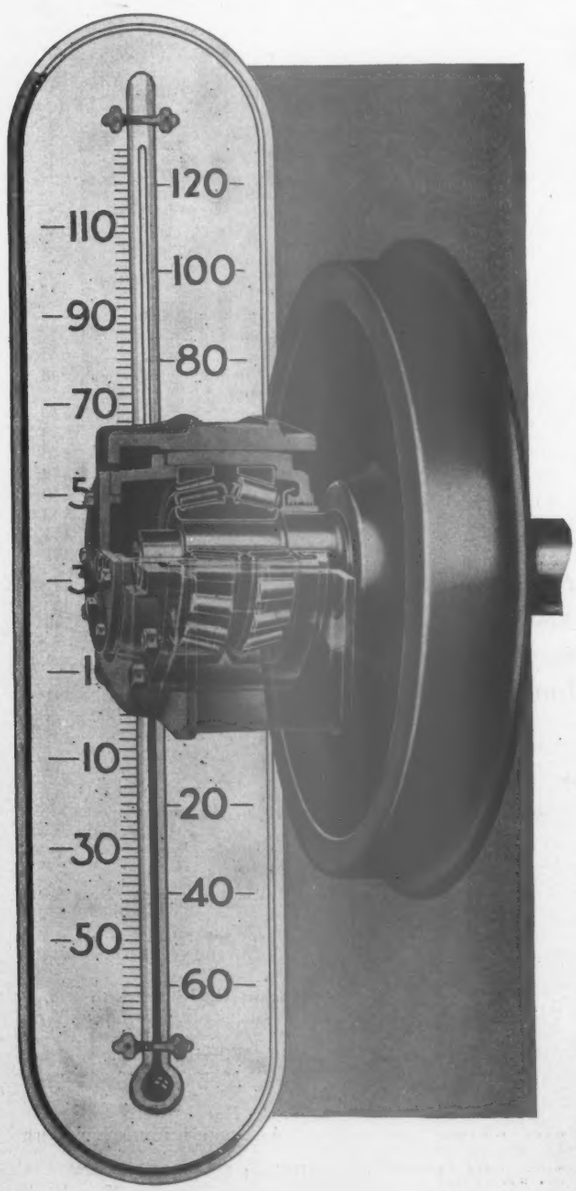

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Railway
Mechanical Engineer

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June - 1931

Chesapeake & Ohio Locomotive Shops at Huntington, W. Va.*

The manufacturing tool room

A detailed analysis of machine operations in the Huntington shops to determine the number, size and capacity of machine tools necessary to produce a balanced operation of all departments

IN designing the locomotive shops at Huntington, W. Va., the mechanical officers of the Chesapeake & Ohio had a definite objective in mind—to provide the maximum locomotive heavy repair capacity with the least possible detention from service and at a minimum expenditure of labor. Exhaustive studies of locomotive repair programs as related to the conditions of operation indicated the desirability of a shop capable of turning out, when operated at maximum capacity, two locomotives which had received Class 2 or 3 repairs for each full working day.

Complete detail time studies were first made to determine the number of machinery operations necessary to repair a given number of locomotives per month which automatically determined the number, size and capacity of the machine tools necessary to produce a balanced shop operation in all of the several departments in the shop. The result of this study was to locate machinery in groups for each separate kind of work and in the proper sequence of operations to avoid all unnecessary handling of parts and materials.

A careful analysis of the time studies indicated the desirability of having several machines in the shop designed by the machine tool builders for special production work so as to be able to meet the output time required on certain parts without unnecessary duplication of machine tool facilities. Among these special machines are certain milling machines used on driving boxes and on shoes and wedges that have made marked reductions in the time required to machine these parts.

The work of the shop is segregated into definite groups and each group has been equipped with such machine tool and shop facilities as will enable that group to perform all of the operations on the parts assigned to it. With very few exceptions each group is a self-contained unit working on one class of locomotive parts and equipped only with those machines required for work on that class of parts. In one or two groups there is sufficient excess machine capacity to permit handling certain operations for other groups where it can be done without the uneconomical handling of parts or material.

Preliminary Time Studies

Detailed analyses were made of the machine-tool

* This is the second article describing the facilities of the Huntington shops—the first appeared in the May issue.

The brass room and air-brake department

operations for all of the groups in the shop. These analyses permitted the tentative selection of the machine units in each group. The time studies for the various operations were based upon the output of a normal number of locomotive parts involved in the process of Giving Class 2 or 3 repairs to the following number and types of locomotives:

33—type 2-8-2 locomotives equipped with superheaters, boosters, feedwater heaters and stokers
9—type 2-6-6-2 Mallet compound articulated locomotives equipped with superheaters and Walschaert valve gear
8—type 2-8-8-2 Mallet simple articulated locomotives, equipped with Walschaert valve gear, superheaters and feedwater heaters

making a total of 50 classified repairs for each working month of 25 eight-hour days.

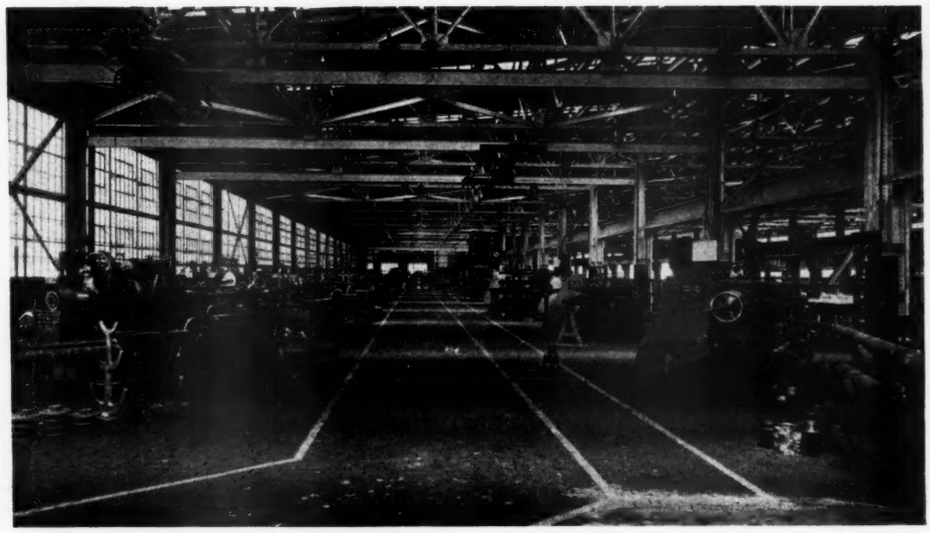
After a tentative selection of machine tools was made for each group the operations were carefully analyzed to determine the possibility of eliminating machines in the original layout by the selection of special machines designed for continuous production. For example, under ordinary railroad shop conditions, using the planer or plain table milling machines with single or double heads the production time on new cast-steel driving boxes would vary from five to seven hours. In the schedule planned for the new Huntington shop on the definite-output basis it is necessary to complete an average engine set of driving boxes in four hours or less. With ordinary machine equipment this would have required the installation of at least two and possibly three machines working on driving boxes alone to care for the finishing of new boxes and the refinishing of new liners on old boxes each month. The problem was met by the installation of a multi-cutter milling machine of special design having a revolving table which permits setting up one set of boxes while the other is being finished. Preliminary estimates allowed 45 minutes as the average time for the milling of the inside faces, edges and shoe and wedge fits. Actual production when the shop is working for maximum output is at the rate of 20 boxes in eight hours or an average time, including set-ups, of 24 minutes for each box. A study on shoes and wedges resulted in the installation of a similar machine which reduced the average time from 30 minutes to less than nine minutes.

Tables I, II and III show in detail the method used in making the machine tool analyses. While similar information was worked up for all the groups in the shop the data shown for Groups 1, 2 and 3 are typical and sufficient to serve as an example of how closely the final layout of the shop resembled the preliminary studies. It will be noticed that the actual machine hours on each operation were increased by 25 per cent to allow for the additional machine-tool capacity required for shop order work in addition to the regular locomotive repair work. It is of interest to note that after a year's operation, the actual percentage of man-hours applied to locomotive repair work averages 76.4 per cent leaving 23.6 per cent of the total shop man-hours for manufacturing and shop order work. The 25 per cent additional machine capacity, in this case, was accurately estimated.

Table IV shows a summary of the estimates of the machine capacity required for all of the groups in the shop. The total machine hours—34,884—shown in the analysis is actually 92 per cent of the potential ma-

Table I—Analysis of Machine Operations Required To Perform 50 Class 2 and 3 Repairs a Month—Group 1—Driving Wheels

Machine and operation	Total no. of parts	Per cent of parts repaired	No. of parts repaired	Time for each part Hr.-Min.	Total machine hours Hr.-Min.	Total time for machining, hr.
96-in. vertical boring mill:						
Bore, turn and face new driving-wheel centers	500	10	50	6 0	300 00	
Bore, turn and face trailer-wheel centers	100	5	5	2 0	10 00	
Bore, turn and face smoke-arch rings	50	5	2½	2 30	6 15	
Turn smoke-box fronts	50	5	2½	1 0	2 30	318.8
Total, plus 25 per cent for shop-order work						398.8
72-in. radial drill:						
Drill and tap counterbalance	500	10	50	1 0	50 00	
Drill main crank pins	134	20	26.8	0 30	13 24	
Drill front and intermediate crank pins	200	20	40	1 0	40 00	
Drill back crank pins	98	20	19.6	0 10	3 16	
Drill and tap driving-wheel centers for hub liners	500	10	50	1 0	50 00	
Drill and tap trailer-wheel center for hub liners	100	5	5	1 0	5 00	161.7
Total, plus 25 per cent for shop-order work						202.1
24-in. Morton keyway cutter:						
Cut keyway in driving-wheel centers	500	10	50	0 20	16 40	
Cut keyway in eccentric arms	100	10	10	0 18	3 00	19.7



View of the Turret lathe department

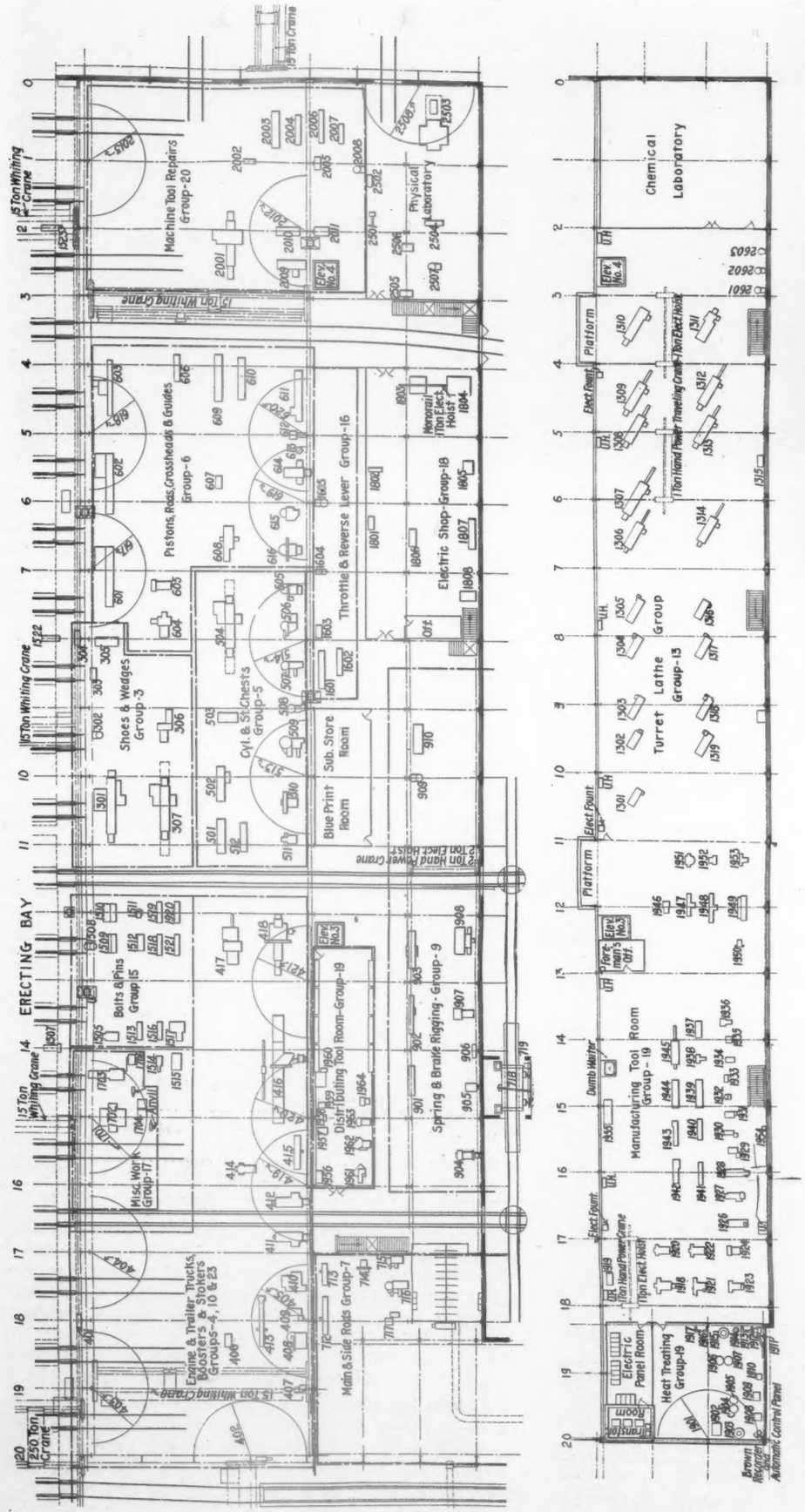
Total, plus 25 per cent for shop-order work								24.6
90-in. double wheel quartering machine:								
Bore crank pin holes in new wheel centers and true up old pins (20 per cent of total pairs used, assuming one new wheel center for each pair of wheels)	250 pr.	20	50 pr.	0	42	35	00	
True-up crank pin holes in old wheel centers and true-up old crank pins	250 pr.	80	200 pr.	0	42	140	00	175.0
Total, plus 25 per cent for shop-order work								218.8
90-in. driving-wheel lathe:								
Turn driving-wheel tires	250 pr.	75	187½ pr.	1	0	187	30	187.5
Total, plus 25 per cent for shop-order work								234.4
90-in. driving-wheel lathe:								
Turn driving-wheel tires	250 pr.	25	62½ pr.	1	0	62	30	
Turn trailer-wheel tires	50 pr.	100	50 pr.	0	35	29	10	91.7
Total, plus 25 per cent for shop-order work								114.6
90-in. journal turning lathe:								
True up and roll journals; face hub liners on driving wheels	250 pr.	75	187½ pr.	1	30	281	18	281.3
Total, plus 25 per cent for shop-order work								351.5
90-in. combination journal turning lathe:								
55-in. combination journal truing and alxe turning machine:								
True up and roll journals; face hub liners on trailer wheels	50 pr.	75	37½ pr.	1	30	56	15	
True up and roll journals; face hub liners on engine truck wheels	50 pr.	75	37½ pr.	1	15	47	00	
True up old trailer-axle journals		30	12	30	0	25	05	50
True up old tender-truck axle journals	250	50	125	0	30	62	30	177.3
Total, plus 25 per cent for shop-order work								221.3
Newton locomotive axle keyseating machine:								
Cut keyways in driving axles	522	25	130½	0	30	65	15	65.3
Total, plus 25 per cent for shop-order work								81.6
30-in. by 8-ft. 6-in. engine lathe:								
Turn driving axles	250	15	37½	5	0	187	30	187.5
Total, plus 25 per cent for shop-order work								234.4
28-in. by 8-ft. 4½-in. double-head axle lathe:								
Turn driving axles	250	10	25	5	0	125	00	
Turn trailer axles	50	25	12½	4	0	50	00	175.0
Total, plus 25 per cent for shop-order work								218.8
24-in. by 5-ft. 6-in. engine lathe:								
Turn and fit main crank pins	134	20	26.8	4	0	107	12	
Fit crank pins, front and intermediate	200	20	40	1	00	40	00	
Thread and fit crank pins, back	98	20	19.6	0	15	4	54	152.1
Total, plus 25 per cent for shop-order work								189.9
24-in. shaper:								
Shape crank-pin keys	134	20	26.8	0	40	17	54	
Shape driving-axle keys	500	25	125	0	40	83	18	
Shape expansion plugs	100	30	30	0	30	15	00	116.2
Total, plus 25 per cent for shop-order work								145.3
600-ton hydraulic driving wheel press:								
Press off driving wheels	250 pr.	35	87½ pr.	0	30	43	45	
Press on driving wheels	250 pr.	35	87½ pr.	0	30	43	45	
Press off trailer wheels	50 pr.	30	15 pr.	0	25	6	15	
Press on trailer wheels	50 pr.	30	15 pr.	0	25	6	15	
Press out crank pins	500	70	350	0	18	105	00	
Press in crank pins	500	70	350	0	18	105	00	
Press off booster-axle gears	6	34	2	0	30	1	00	
Press on booster-axle gears	6	34	2	0	30	1	00	312.0
Total, plus 25 per cent for shop-order work								390.0
60-in. by 72-in. tire-heating furnace								
Counterbalancing stand								
Lead melting pot and furnace								
Two portable electric-welding outfits								
One double dry grinder								
Total number of machine hours for Group No. 1 required for 50 locomotives a month								2,421.1
Total number of machine hours plus 25 per cent for shop-order work								3,026.4

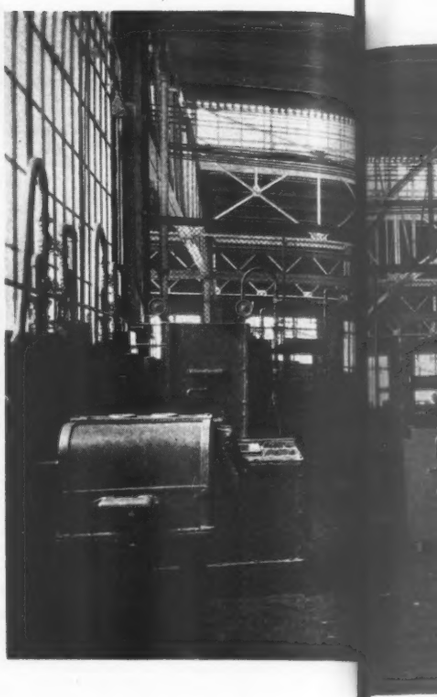
chine capacity of the 190 machines in the shop that are operated on locomotive repair and shop order work. This not only indicates the accuracy of the preliminary studies but corroborates the statement that there was practically no duplication of machine tool units between the different groups.

Group Operations

The drawings showing the layout of the several bays and departments of the shop show the location of the machine tools and other facilities in each group.

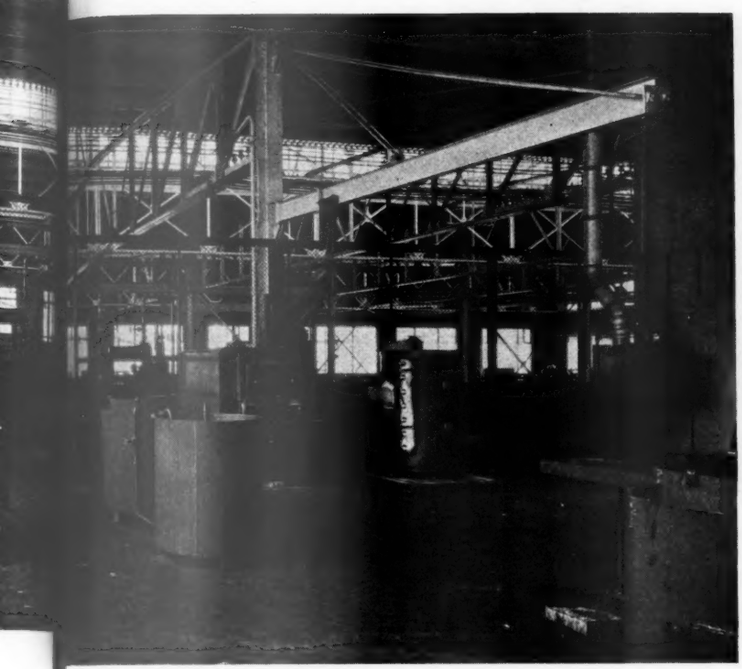
Group No. 1—The locomotives are lifted off the wheels on track No. 22 in the erecting bay and rolled in-


ERECTING BAY
Machine Tool Repairs Group-20
Physical Laboratory
Pistons, Rods, Crossheads & Guides Group-6
Throttle & Reverse Lever Group-16
Electric Shop Group-18
Shoes & Wedges Group-3
Cyl. & Stichests Group-5
Blue Print Room
Sub. Store Room
Bolts & Pins Group 15
Misc. Work Group-17
Distr. Tooling Tool Room-Group-19
Spring & Brake Rigging-Group-9
Engine & Trailer Trucks, Boosters & Stokers Groups-4, 10 & 23
Main & Side Rods Group-7
Chemical Laboratory
Turret Lathe Group-13
Manufacturing Tool Room Group-19
Heat Treating Group-19
Electric Panel Room
Brown Recorder and Automatic Control Panel
15 Ton Whiting Crane
250 Ton Crane



Above—Furnaces in the tool heat-treating department, all of which are equipped with recording pyrometers and are fitted with automatic temperature control devices.

Left—The two machine bays and the West Side balcony—The greater part of the machine work is handled in these two bays while the second floor of the west side of the shop contains the tool room, turret lathe department and the chemical laboratory



to the wheel bay where the driving boxes are removed. The grease cellars are taken apart and any remaining grease is placed in a container for delivery to the oil house. The wheels are then placed in the large lye-vat at the north end of the wheel bay and left there a sufficient length of time for thorough cleaning. After removal from the cleaning vat they are placed on the grating adjacent to the vat and washed off with clean water; all finished surfaces are greased and the wheels are placed on the storage track in sets until they are scheduled to start on the rounds of the repair process.

The equipment in the wheel shop is so arranged that after the wheels are properly inspected, the tires and axles OK'd or condemned and the crank pins OK'd for turning or condemned, the tires are removed if necessary, the counterbalance is checked and, if necessary, new tires are applied. The mounted wheels are then delivered to the wheel press where the axles and crank pins condemned by the inspector are pressed out and new axles are applied, the wheels are delivered to the quartering machine to have the crank-pin holes quartered and then returned to the press to have the new crank pins applied. On wheels where the axles are not removed they are delivered to the wheel press for crank-pin removal, thence to the journal-truing lathe for turning up the journals before sending to the quartering machine. After the crank-pin holes have been bored and the wheels quartered the mounted wheels are returned to the press to have the crank pins pressed in. The completed wheels, at this stage, are at tracks 11 or 12 from which the movement to any track in the erecting shop is over the shortest possible distance. A detailed analysis of operations is shown in Table I.

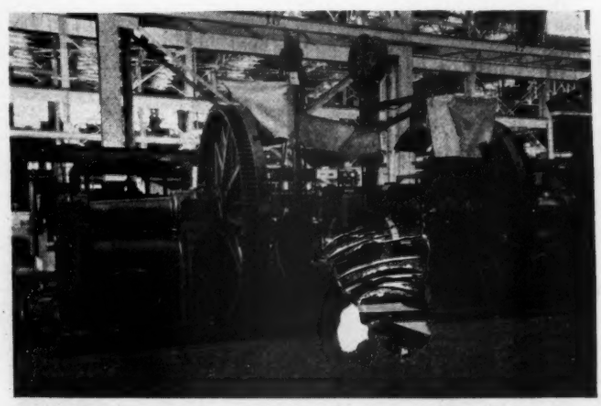
Group No. 2—When the driving boxes are removed from the wheels they are placed in metal baskets and placed in the lye vat for cleaning. After cleaning they are delivered to the driving box repair group where the process of repair is as follows:

1—Press out the old crown brass.
2—Cut off the driving-box hub liner on vertical turret lathe.
3—Remove the shoe and wedge liner when it will not finish ¾ in. below standard.
4—True up crown-brass fit on driving box shaper.
5—Drill and tap holes for new patch bolts.
6—Fit new crown brass on drawcut shaper.
7—Press in new crown brasses on hydraulic press.
8—Drill and ream holes in new crown brass.
9—Apply brass hub liner and shoe and wedge liners where necessary with brass melted in electric furnace.
10—Finish shoe and wedge surfaces on semi-automatic miller.
11—Restore driving-box cellar fit to standard.
12—Fit the cellar to the box and remove cellar.
13—Store driving boxes with cellars removed until orders for final finishing are received from the erecting shop on suitable forms provided for the purpose.
14—Bore and face driving boxes on orders from the shop.
15—Drill oil holes.
16—Complete bench work and deliver to two-ton hand-driven cranes for handling boxes while fitting onto finished driving wheels.
17—Apply suitable spreader to prevent boxes from turning over and deliver driving wheels in complete sets to the extension tracks from the erecting shop into the wheel bay in front of the engines to which they belong.

A detailed analysis of machine operations is shown in Table II.

Table II—Analysis of Machine Tool Operations Required To Perform 50 Class 2 and 3 Repairs a Month—Group No. 2—Driving Boxes

Machine and operation	Total no. of parts	Per cent of parts repaired	No. of parts repaired	Time for each part Hr.	Time for each part Min.	Total machine hours Hr.	Total machine hours Min.	Total time for machining, hr.
36-in. by 16-ft. three head driving-box milling machine:								
New driving boxes—mill inside faces, edges and shoe and wedge faces; one set-up	500	10	50	0	45	37	30	
Mill shoe and wedge faces of old driving boxes after new liners (brass) have been poured	500	100	500	0	15	125	00	162.5
Total, plus 25 per cent for shop-order work								203.1
48-in. by 18-ft. planer:								
Dovetail shoe and wedge faces on new driving boxes	500	10	50	1	0	50	00	50.0
Total, plus 25 per cent for shop-order work								62.5
42-in. Bullard vertical turret lathe:								
Face new driving boxes and dovetail for hub liners	500	10	50	1	30	75	00	
Cut-off hub liners and true dovetail on old driving boxes	500	90	450	0	20	150	00	225.0
Total, plus 25 per cent for shop-order work								281.3
54-in. driving-box boring and facing machine:								
Bore and face hub plates on old and new driving boxes.	500	100	500	0	25	208	00	208.0



Wheel lathe equipped for building up wheel centers by electric welding

Part of the jacket shop in the foreground with the air-pump department shown in the background

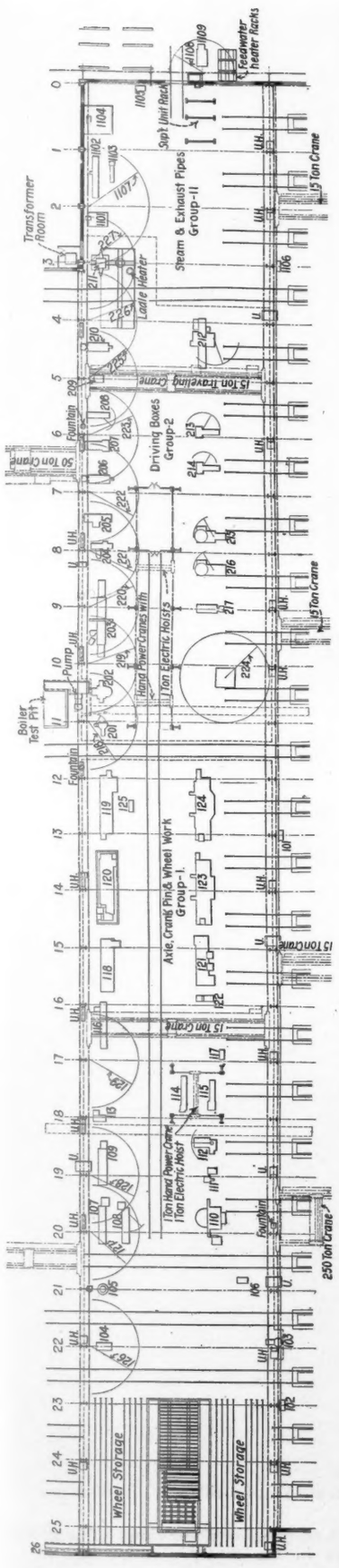
Total, plus 25 per cent for shop-order work								260.0
30-in. driving-box slotter:								
Slot driving-box crown brass and cellar faces (new boxes)	500	10	50	0	40	33	18	
True up crown-brass face of old driving boxes	500	90	450	0	20	150	00	183.3
Total, plus 25 per cent for shop-order work								229.1
30-in. Morton draw-cut shaper:								
Plane crown brass on new and old driving boxes	500	100	500	0	48	400	00	400.0
Total, plus 25 per cent for shop-order work								500.0
30-in. Morton draw-cut shaper:								
Shape driving-box cellars	500	20	100	0	30	50	00	50.0
Total, plus 25 per cent for shop-order work								62.5
4-ft. radial drill with 6-ft. arm:								
Drill and tap new driving boxes for hub liners and shoe and wedge liner bolts	500	10	50	1	30	50	00	
Drill and tap old driving boxes for hub liner and shoe and wedge liner bolts	500	60	300	0	30	150	00	200.0
Total, plus 25 per cent for shop-order work								250.0
4-ft. radial drill with 6-ft. arm:								
Drill and ream driving boxes for crown brass plugs (new boxes)	500	10	50	0	20	16	42	
Drill and ream driving boxes for crown brass plugs (old boxes)	500	90	450	0	10	75	00	91.7
Total, plus 25 per cent for special-order work								114.6
4-ft. radial drill with 6-ft. arm:								
Drill new driving boxes and cellars and tap for bolts	500	10	50	0	20	16	42	
Drill old driving boxes and cellars and tap for bolts	500	90	450	0	10	75	00	
Drill oil holes in new driving boxes	500	10	50	0	20	16	42	
Drill oil holes in old driving boxes	500	90	450	0	15	112	30	220.9
Total, plus 25 per cent for shop-order work								276.1
100-ton hydraulic press (vertical):								
Press out crown brasses	500	100	500	0	5	41	42	41.7
Total, plus 25 per cent for shop-order work								52.1
100-ton hydraulic press (vertical):								
Pressing in crown brasses	500	100	500	0	5	41	42	41.7
Total, plus 25 per cent for shop-order work								52.1
Electric brass furnace:								
Casting hub liners and shoe and wedge liners on driving boxes	500	100	500	0	30	250	00	250.0
Total, plus 25 per cent for shop-order work								312.5
Total no. of machine hours in Group No. 2 for 50 locomotives a month								2,124.8
Total no. of machine hours plus 25 per cent for shop-order work								2,655.9

Group 3—When the shoes and wedges are removed from the locomotives they are placed in the cleaning vat for the removal of grease and dirt and then delivered to the shoe and wedge group where they are inspected, liners applied where necessary to all except main-wheel shoes and wedges and then they are matched up into sets for delivery to the erecting shop for the purpose of being laid off to line. New shoes and wedges are machined on a 36-in. Newton milling machine with a special table which permits setting up one set while the other is being machined. On this machine the shoes and wedges are milled on the outside for the driving-box fit and on the inside for the frame fit. A 24-in. vertical drill press takes care of the drilling of shoes and wedges for liners. When the shoes and wedges are returned from the erecting shop they are struck off to line and planed. A detailed analysis of machine operations is shown in Table III.

Group 4—This group of machines takes care of such work as pilot beams, deck castings and special parts required at infrequent intervals.

Group 5—In this group cylinder bushings are bored, turned and cut off. Cylinder and piston-valve heads, valves, balance plates, false valve seats and valve yokes are planed on a crank planer. Equalizer and brake fulcrums, brake hangers and levers, throttle lever and reverse-lever parts are machined on a crank planer. This group also looks after the work with portable boring bars on boring out and truing-up valve-chamber bushings and cylinder bushings. Cylinder and piston-valve packing rings are machined here. The 42-in. vertical turret lathes bore, turn and face piston-valve followers and bushings, cylinder heads and piston-valve heads. An 18-in. slotter performs a variety of operations on valve yokes and followers, throttle-lever yokes and fulcrums, equalizers, spring hangers, spring saddles and driver-brake hanger and fulcrum brackets. A No. 4 milling machine mills the ports in piston-valve bushings and false valve seats and performs a number of operations on throttle- and reverse-lever parts.

Group 6—This group is equipped with sufficient machinery to handle all necessary repairs to pistons and



Wheels and driving boxes are handled in this bay

rods, crossheads and guides. New bull rings are applied to piston spiders by machines that are grouped together and served by a jib crane, a drill press for drilling the new bull rings, a pneumatic riveter for driving the new rivets and an electric heater for heating the rivets. There is also a 200-ton press in this group, served by the same crane, for the application of new piston rods. Locomotives receiving classes 1, 2 or 3 repairs have the piston rods ground or renewed, and the valve stems and slide-valve yoke stems are ground, fitted up with packing rings and provided with suitable protection for transportation to the erecting floor. All piston rods and valve stems are coated with grease after fitting up to prevent rusting.

Table III—Analysis of Machine Tool Operations Required To Perform 50 Class 2 and 3 Repairs a Month —Group No. 3—Shoes and Wedges

Machine and operation	Total no. of parts	Per cent of parts repaired	No. of parts repaired	Time for each part Hr.-Min.	Total machine hours Hr.-Min.	Total time for machining, hr.
36-in. by 16-ft. horizontal milling machine:						
Mill shoes and wedges on inside and outside (new)	1000	75	750	0 9	112 30	112.5
Total, plus 25 per cent for shop-order work						140.6
24-in. vertical drill press:						
Drill old shoes and wedges for liners	1000	25	250	0 6	25 00	25.0
Total, plus 25 per cent for shop-order work						31.3
38-in. by 14-ft. planer:						
Plane shoes and wedges to line	1000	75	750	0 15	187 30	187.5
Total, plus 25 per cent for shop-order work						234.5
32-in. crank planer:						
Plane shoes and wedges to line	1000	25	250	0 25	104 12	104.2
Total, plus 25 per cent for shop-order work						130.3
Total number of machine hours for Group No. 3 for 50 locomotives a month						429.2
Total number of machine hours plus 25 per cent for shop-order work						536.5

The guides on all locomotives receiving Classes 1, 2 and 3 repairs are ground on the three wearing surfaces on a guide grinder. Bronze crosshead shoes are manufactured in quantities on the shoe and wedge milling

Below—A view of the tin shop on the second floor of the North wing of the Mallet shop

machine mentioned in Group 3. The guide fit of these new crosshead shoes is machined to the smallest standard size and fitted on a crank planer to the guides with which they are to be used.

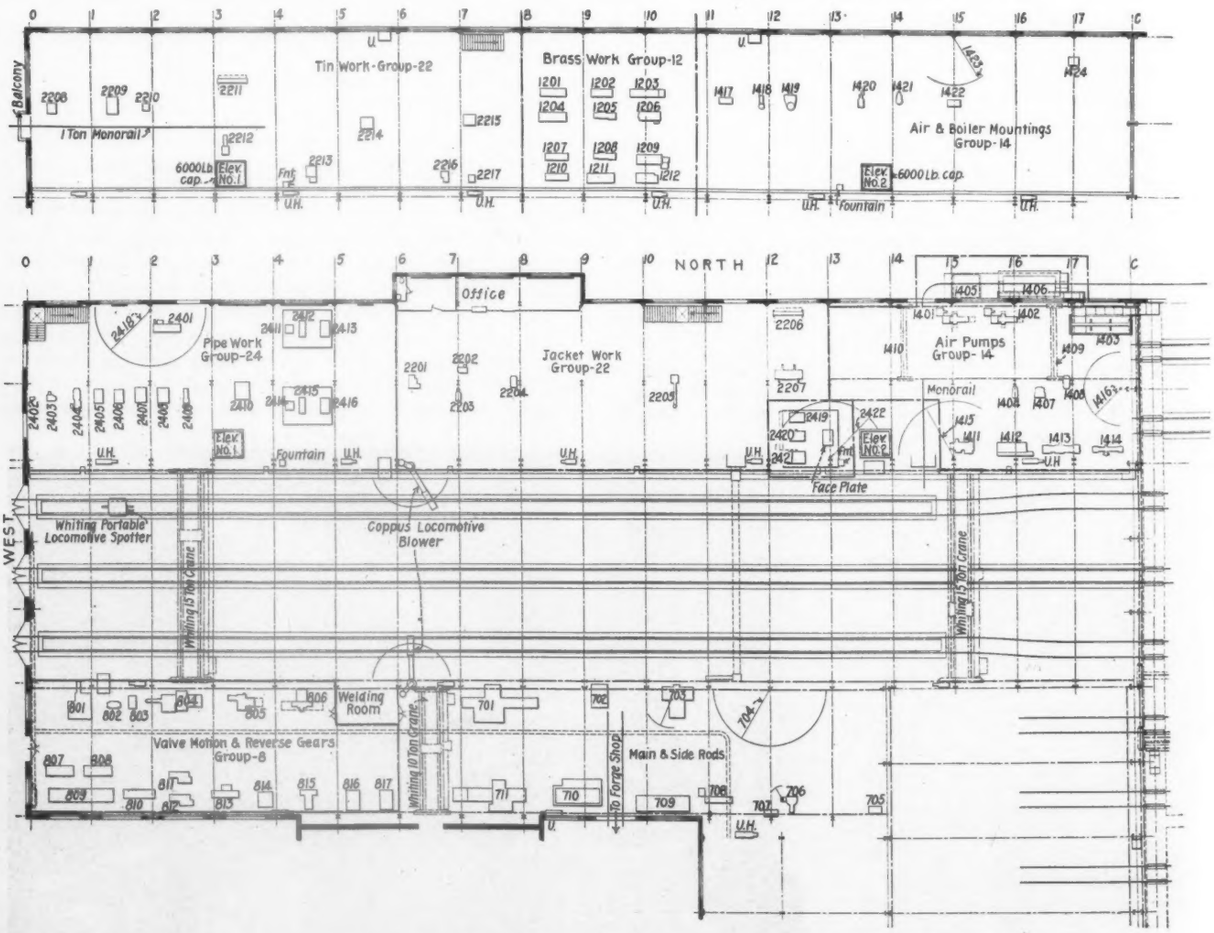
Group 7—Main and side rods are removed from the locomotives in the stripping section of the shop adjacent to the rod department. When delivered to this group they are cleaned and inspected, annealed if necessary and fitted with new brasses, restored to standard length and delivered to the erecting shop. All new main and side rods for the entire system are manufactured at the Huntington shop.

New main and side rods and rod straps are machined on a 48-in. horizontal milling machine. A 54-in. milling machine mills the rods to length, mills the ends and straps and the forked ends of side rods. A 15-in. slotter handles a variety of jobs on motion work while several types of drilling machines handle the drilling work in this group. A double-head rod boring mill bores the new side rods, back-end main-rod straps and the front end of main rods for the bushings.

Rod bushings are turned and bored on a 24-in. vertical turret lathe and knuckle pins, knuckle-pin bushings and main-rod strap bolts are finished up on engine lathes. A 50-ton power press presses the rod and knuckle-pin bushings out and in.

Group 8—The location of this group adjacent to the stripping and finishing tracks where the valve-motion parts are removed and applied permits the overhauling of the parts with a minimum of handling. After the

The North side of the shop—The coal transfer conveyor is shown in the distance and the monorail hoist for handling air pumps to the cleaning vat and to storage is shown on the side of the building



Above: The second floor of the North side of the shop which is devoted to light tin and brass work—Below: The ground floor of the Mallet shop with the stripping and finishing tracks in the center

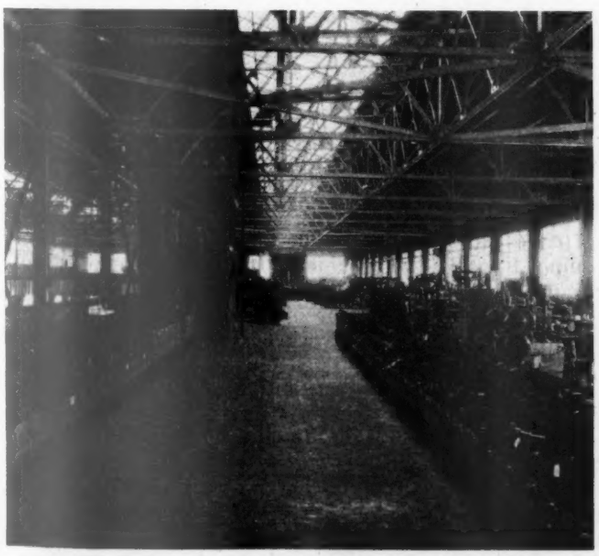
parts are removed from the locomotives they are placed in metal baskets and thoroughly cleaned in the lye vat before delivery to the valve-motion group. In this group

Table IV—Summary of Estimated Machine Hours Required in Various Groups to Perform 50 Class 2 and 3 Repairs a Month

Group no.	Department	Straight machine hours	Total, plus 25 per per cent for S.-O. work	No. machines involved
1	Driving wheels, engine- and trailer-truck wheels, axles and crank pins	2421.1	3026.4	17
2	Driving boxes	2124.8	2655.9	16
3	Shoes and wedges	429.2	536.5	4
4	Frames, deck and draw castings, deck and pilot beams	1578.5	1973.2	14
5	Cylinders and heads, steam chests and valves	3371.8	4214.1	17
6	Pistons and rods, crossheads and guides	1691.8	2114.1	16
7	Main and side rods	1718.7	2148.5	14
8	Valve and reverse gear	2753.1	3440.3	18
9	Spring and brake rigging	1979.8	2474.7	10
10	Engine and trailer trucks, boosters and stokers	See Group No. 4	.....	..
11	Steam and exhaust pipes, superheaters and units, and feedwater heaters	235.9	294.9	2
12	Brass work, cab and boiler mountings	1636.4	2045.5	13
13	Turret-lathe work	4119.2	5149.0	19
14	Air-brake and pneumatic devices	1061.0	1327.0	10
15	Bolts and pins	2550.0	3187.5	18
16	Drifting, intercepting and by-pass valves; throttle, reverse-lever and cylinder-cock rigging	217.0	271.2	2
23	Miscellaneous work, grate and ash-pan rigging and large castings	See Group No. 4	.....	..
	Totals	27888.9	34859.4	190

are all of the machines and other equipment necessary to complete the manufacture and repair operations. The completed parts are finished all over and are polished with portable buffing machines.

All of the motion pins and bushings used on the C. & O. are finished to standard size and gage so that the fitting is a matter of the selection of the proper sizes from stock. Motion pins are manufactured on turret lathes after which they are hardened and ground. The straight body of the pin is ground to a standard size for the part involved and the taper fits for the rods are ground in step sizes on a taper of ¾ in. in 12 in. Plug gages are used for selecting the sizes and these gages are marked A, B, C and D, the markings of the gage being ½ in. apart and varying, on the ¾-in. in 12-in. taper, 1/32 in. in diameter for each step. The pins in stock are similarly marked. The taper fits on the pins are ground so as to leave 1/32 in. clearance between the shoulder on the pin and the inside of the rod jaw for drawing up. Motion bushings are of standard inside diameters and the outside diameters are ground to four step sizes.



Small parts and materials are handled almost entirely on skids

Group 9—When the brake and spring-rigging parts are removed from the locomotives they are taken to the annealing furnace to have the grease burned off and as soon as cold are delivered into storage. This group is provided with sufficient machinery to be self-supporting, except for bushings, which are manufactured to standard gage in the turrent-lathe group. All brake and spring-rigging parts when undergoing repairs are restored to original blueprint dimensions.

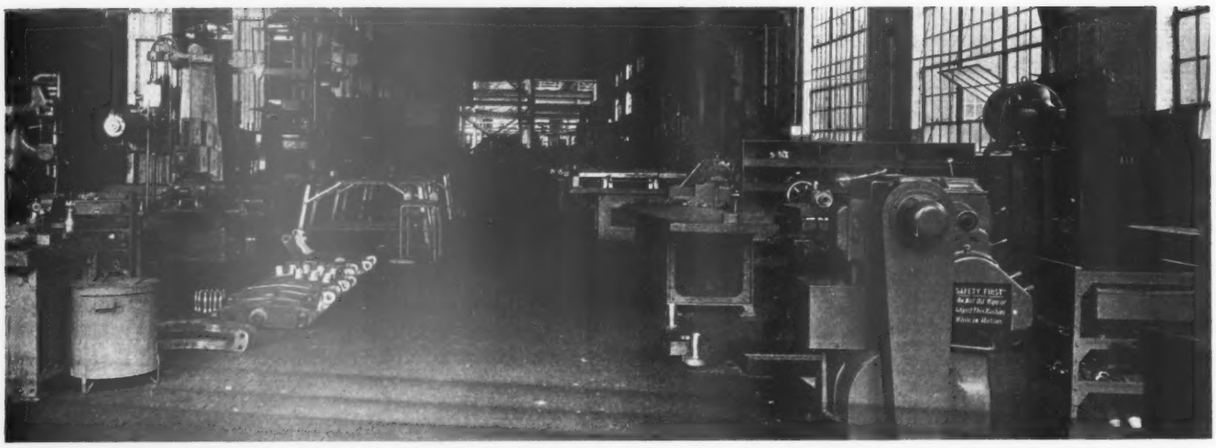
Group 10—The machine work for this group is combined with that of Groups 4 and 23 most of it being of a special nature on engine and trailer trucks, boosters and stokers. The group is self-supporting as far as machinery is concerned and is equipped with a steam hammer for fitting braces, binders, etc.

Group 11—This group is located at the south end of the wheel bay and handles all of the steam and exhaust-pipe work, including throttle boxes, feedwater-heater drums and the testing and repairing of all superheater units. The material awaiting repairs is stored immediately outside the shop under the south crane runway. There is a small cleaning vat located in this group for cleaning feedwater-heater-tube bundles.

Group 12—This is the manufacturing brass department. Here all cab and boiler mountings and air-brake equipment except pumps are repaired. The cab and boiler mountings are removed from the locomotives in the stripping position and the parts are placed in specially designed metal boxes which are handled by lift trucks. Two types of boxes are used, one for boiler mountings that will be required to make the boiler water-tight for test, including blow-off cocks, boiler checks, safety valves, auxiliary domes and washout and arch plugs and the other box for cab mountings and air-brake apparatus such as brake valves, distributing valves, headlight generator, injector, lubricator, steam and air gages and similar equipment. These boxes are arranged with suitable partitions providing space for each of the articles. When the stripping is completed the boxes are delivered to the brass group on the second floor of the north bay of the longitudinal shop by means of the elevator where they are placed on lift skids until the parts which they contain are scheduled for repairs. Upon completion of the repair work on the parts, the box containing the boiler mountings necessary to fit the boiler for water test is delivered to the erecting shop and box No. 2 is delivered to the finishing tracks with the air-brake apparatus and trimmings.

Group 13—This is the turret-lathe group located on the second floor over the light machine bay. It is a manufacturing group and all of the work of this group is handled on a production basis in small or large lots.

Group 14—This group is located adjacent to the stripping position where air pumps, feedwater-heater pumps, pneumatic fire doors, grate shakers and power reverse gears are removed from the locomotive. When these parts are taken off they are placed on the floor under the end of a monorail crane which runs to the outside of the north end of the shop and along the shop wall. There is a break in the crane runway and a monorail traveling crane having two 4,000-lb. trolleys operates on another runway at right angles to the first runway and serves the entire floor area of the air-pump repair group where the large units must be handled in making repairs.



Above — Valve motion and reverse gear group

Left — Machine tool equipment used in the air - pump department

Three Micro grinders handle the internal grinding on air-pump, feedwater-heater pump, stoker-engine cylinders and reverse-gear cylinders and a Landis 16-in. by 72-in. horizontal grinder takes care of the work on pump and reverse-gear piston rods.

Air-Compressor Test Rack

In this group there is a pump test rack of sufficient size to accommodate all of the pumps that may be necessary to test at one time. The pumps are mounted on the test rack with special bolts of the "fitting-up" type using a tapered key so that they may be mounted and removed with practically no loss of time except that required to remove the pipe fittings. All pumps are tested under steam and the compressed air is piped into the shop air line while the exhaust steam goes into the low-pressure shop heating system.

A handy piston storage rack constructed of structural shapes permits the storage of about 40 pistons at a time. The holes in the horizontal bars of the rack are two inches in diameter to accommodate the largest rod and are fitted with copper ferrules to prevent damage to the finished surface of the rod.

Group 15—All bolts are manufactured in this group to stock sizes. Tapered bolts are manufactured to standard gage sizes and locomotive taper reamers are equipped with collars and index numbers corresponding to their size, the purpose of which is to ream the holes to standard size as determined by the collar on the reamer and then obtain from stock a bolt already turned which is then cut off to the proper length and threaded.

Group 16—This group contains the necessary machine equipment for repairing intercepting and by-pass valves, reverse and throttle levers and cylinder-cock rigging.

The pipe and tin shop is located adjacent to the stripping and finishing positions. When the pipe work is removed from the engine it is taken to the shop where it is inspected. The pipe which is unfit for further service is scrapped and the rest is repaired and stored on racks just outside the shop until needed for re-application to the engine when it goes out of the shop.

The jackets are removed and sent to the jacket shop for examination. Damaged or worn parts are scrapped and replaced while all the good parts are stored on racks outside the north side of the jacket shop until needed for re-application.

The tin work in this department involves the repair of tin ware and is handled on the second floor over the pipe shop. The small parts are handled in boxes on an elevator and the larger pieces are handled on a hoist at the west end of the shop which raises them to a platform on the second floor where they are handled through the shop on a monorail hoist.

Other Departments

Group 20 is a machine-tool repair department equipped with new machines. It handles machine tool repairs for all points on the C. & O. system. Machines requiring major repairs or overhauling are shipped to Huntington to have this work performed.

A blueprint room is located on the main floor of the shop for the filing and distribution of blueprints to the shop. A blueprint machine is located here for use in making prints from shop tracings made in the shop draftsman's department.

Sub-store rooms each in charge of a storekeeper issue small bolts, nuts and washers, cotter keys, marking chalk and other small supplies that are required for the application of ash pans, front-end and various other patching around a locomotive, the needs for which cannot be ac-

curately determined in advance. This avoids delay in the erecting shop.

Distributing tool rooms are located in the boiler shop and the machine shop. The one in the machine shop is located under the manufacturing tool room on the second floor and the transportation of small tools is effected by means of a dumb waiter.

Group 18—The electrical repair shop is located near the southwest corner of the shop under the turret-lathe department and is equipped with all the necessary apparatus for repairing and testing headlight and train-control equipment as well as motors, generators, electric storage-battery trucks and other electrical apparatus for the entire system.

In the extreme southwest corner of the shop is located a physical testing laboratory and directly overhead on the second floor a chemical laboratory. These laboratories are completely equipped with the usual testing and chemical apparatus and the work is handled under the supervision of the mechanical engineer and engineer of tests for the entire system.

Machine Tools and Shop Equipment in the Huntington Locomotive Shops

GROUP 1—WHEELS AND AXLES

101, 102 Hisey-Wolf double-end dry grinders
103 Hyde 15-in. electric Gypsy
104 Swift electric tire heater
105 Stewart No. 8 soft metal melting furnace (Spencer turbo-compressor)
106 Westinghouse 200-amp. portable electric arc welder
107 Betts 30-in. extra heavy end-drive axle lathe
108 Niles 28-in. two-carriage axle lathe
109 Newton locomotive axle keyseat milling machine

(Machine Tools and Shop Equipment—Continued)

110 Betts 96-in. boring mill
111 Morton 24-in. keyseater
112 Niles 72-in. radial drill
113 Steptoe 24-in. shaper
114 Betts 26-in. geared-head lathe
115 Lodge & Shipley 24-in. engine lathe
116 Niles 96-in. 600-ton hydrostatic wheel press
117 Safety double-end emery grinder
118 Putman 90-in. journal lathe
119 Niles 90-in. driving wheel journal lathe
120 Niles 90-in. wheel-grinding machine
121 Niles 84-in. driving-wheel lathe (equipped for welding driving-wheel centers)
122 General Electric motor-generator set
123, 124 Sellers 90-in. driving-wheel lathes
125 Westinghouse 200-amp. portable electric arc welder
126, 127, 128 20-ft. 4,000-lb. jib cranes; 2-ton American "Lo-hed" electric hoists
129 20-ft. 5-ton jib crane; 5-ton American "Lo-hed" electric hoist

GROUP 2—DRIVING BOXES

201 Watson-Stillman 100-ton hydraulic press
202 Colburn vertical boring and turning mill
203 Sellers 48-in. by 48-in. by 18-ft. planer
204 Baker 30-in. slotter
205 Morton 38-in. draw-cut shaper
206, 210 American 6-ft. plain radial drills
207 Morton 32-in. draw-cut shaper
208 Morton 30-in. draw-cut shaper
209 Chambersburg 100-ton hydraulic forcing press
211 Detroit Standard type A electric brass-melting furnace
212 Newton L 66 driving-box milling machine
213 Morton 36-in. draw-cut shaper
214 Morton 32-in. draw-cut shaper
215, 216 Sellers 54-in. boring and facing mills
217 American 6-ft. plain radial drill
218, 219, 220, 221, 222, 223, 225, 226 20-ft. 4,000-lb. jib cranes; 1-ton American "Lo-hed" electric hoists
224 19-ft. Conkey 1½-ton mast crane; 1-ton American "Lo-hed" electric hoist
227 20-ft. 4,000-lb. jib crane; 2-ton American "Lo-hed" electric hoist

GROUP 3—SHOES AND WEDGES

301 Newton special shoe and wedge milling machine
302 Edlund round-column drilling machine
303 Hisey-Wolf double-end dry grinder
304 Bridgeport 16-in. by 3-in. double-end dry grinder
305 Cincinnati 32-in. back-geared shaper
306 Newton 32-in. crank planer
307 Niles 44-in. by 44-in. by 14-ft. planer

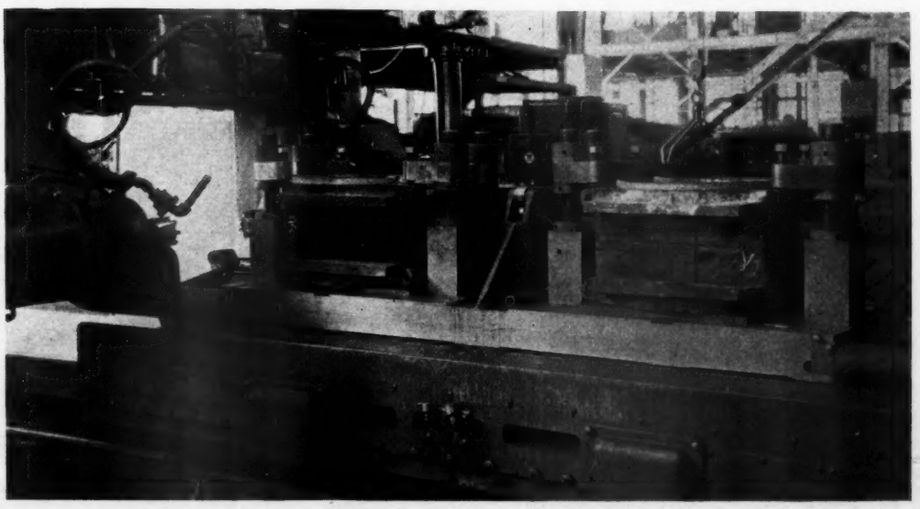
GROUPS 4, 10 AND 23—PILOT BEAMS, DECK CASTINGS, AND UNUSUAL JOBS

401, 406 Hisey-Wolf double-end dry grinders
402, 403, 404 40-ft. 4,000-ton jib cranes; 2-ton American "Lo-hed" electric hoists
405 20-ft. 4,000-lb. jib crane; 1-ton American "Lo-hed" electric hoist
407 Champion 20-in. upright drill
408 Bullard 42-in. vertical turret lathe
409 Gould & Eberhardt 24-in. back-geared shaper
410 5-ft. radial drill
411, 412 American 6-ft. radial drills
413 Lodge & Shipley 22-in. by 12-ft. engine lathe
414 Niles-Bement-Pond 18-in. slotter
415 Lodge & Shipley 24-in. by 5-ft. 6-in. engine lathe
416 Gray 48-in. by 48-in. by 18-ft. open-side planer
417 Ohio Model 5-T horizontal boring and drilling machine
418 Niles-Bement-Pond 42-in. by 14-ft. planer
419, 420 20-ft. 4,000-lb. jib cranes; 2-ton American "Lo-hed" electric hoists

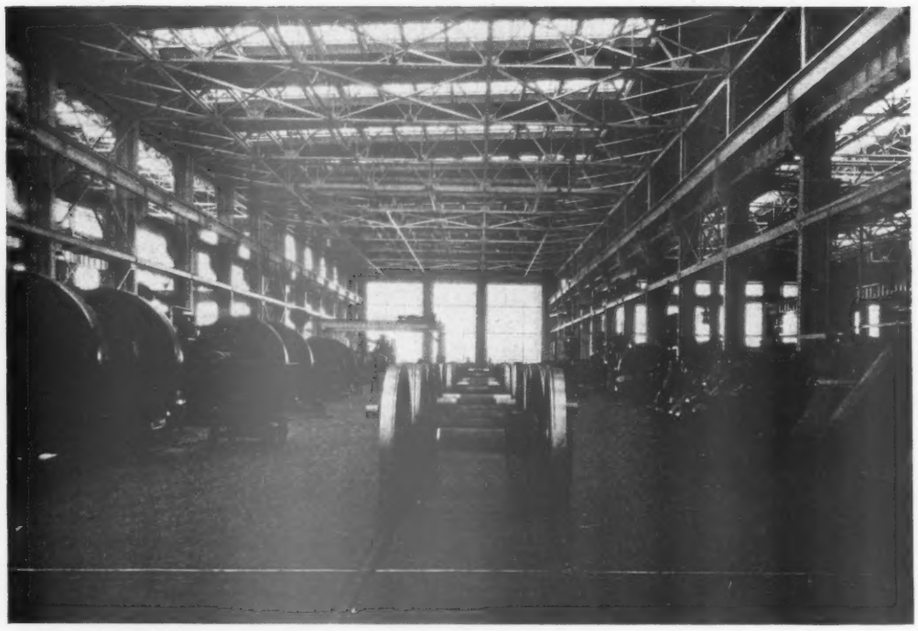
GROUP 5—CYLINDERS AND STEAM CHESTS

501 Lodge & Shipley 27-in. engine lathe
502 Newton 32-in. crank planer
503 Bement-Miles 15-in slotter
504 Niles 48-in. by 48-in. by 14-ft. planer
505 King 42-in. vertical turret lathe
506 Niles 42-in. vertical turret lathe
507 Bullard 36-in. vertical turret lathe

Above — Independent, small-capacity cranes and jib cranes are used to relieve the demand on the larger main-shop cranes



Right—A special driving box miller which can machine 20 new driving boxes in eight hours



View of the wheel bay showing the heavy machinery, aisle room and the wheel tracks.

508 Barnes No. 3, 34-in. drill
509 Bullard 54-in. vertical turret lathe
510 Cincinnati No. 4 plain milling machine
511 Le Blond No. 3 universal milling machine
512 Boye & Emmes 18-in. by 4-ft. 8-in. engine lathe
513, 514 20-ft. 4,000-lb. jib cranes; 1-ton electric hoists

GROUP 6—Piston Rods

601, 602 Diamond 30-in. face grinders
603 Landis 16-in. by 40-in. by 120-in. grinder
604 Newton 32-in. by 32-in. by 32-in. crank planer
605 Baker 18-in. vertical drill
606 Reed 20-in. engine lathe
607 Hisey-Wolf double-end dry grinder
608 Niles No. 3 double cotter drill
609 Bullard 34-in. engine lathe
610 American 20-in. by 14-ft. engine lathe
611 Chambersburg 66-in. 400-ton high-speed wheel press
612 Hanna 12-in. by 12-in. 50-ton riveter
613 Berwick No. 3 electric rivet heater
614 American 4-ft. plain radial drill
615 Bullard 36-in. vertical turret lathe
616 Colburn 42-in. vertical boring and turning mill
617, 618, 619, 620 20-ft. 4,000-lb. jib cranes with 1-ton American "Lo-hed" electric hoists

GROUP 7—Main and Side Rods

701 Newton 48-in. horizontal rod milling machine
702 Niles-Bement-Pond No. 10 vertical milling machine
703 Newton 54-in. single-spindle vertical rod milling machine
704 18-ft. radius jib crane, 4,000-lb. capacity, 1-ton electric hoist
705 Edlund round-column drilling machine
706 Watson-Stillman 100-ton hydraulic press
707 Hisey-Wolf double-end dry grinder
708 Micro FG 18-in. grinder
709 Newton S-27 duplex rod boring machine
710 Sellers 84-in. radial drill
711 Ingersoll 54-in. by 16-in. horizontal rod milling machine
712, 713 Lodge & Shipley 18-in. by 12 ft. engine lathes
714 Gould & Eberhardt 20-in. shaper
715 Bullard 24-in. vertical turret lathe
716 Bullard 36-in. vertical turret lathe
717 Morton 18-in. keyseater
718 DeRemer-Blatchford car-bottom annealing furnace
719 Buffalo direct blower

GROUP 8—Valve-Motion Parts

801 Newton radius link grinder
802 Hisey-Wolf double-end dry grinder
803 Edlund 24-in. drill press
804 Ohio 4-T horizontal boring, drilling and milling machine
805 Newton 32-in. crank planer
806 Kempsmith No. 5 plain high-power milling machine
807, 808 Monarch 18-in. by 8-ft. geared head lathes
809 Niles 56 in. engine lathe
810 Boye & Emmes 18-in. engine lathe
811, 812 Landis 6-in. by 18-in. plain grinding machines
813 Heald No. 72-A internal grinding machine
814 Gould & Eberhardt 20-in. shaper
815 Baker 18-in. vertical drill
816 Bullard 36-in. vertical turret lathe
817 Bement Miles 15-in. stroke slotter

GROUP 9—Spring and Brake Rigging

901 Reed 20-in. engine lathe
902 Lodge & Shipley 18-in. by 12-ft. engine lathe
903 Lodge & Shipley 30-in. engine lathe
904 Foote-Burt 36-in. vertical drill
905 Champion upright 20-in. drill
906 Hisey-Wolf double-end dry grinder
907 Baker 18-in. vertical drill
908 Colburn special 3-spindle drilling machine
909 Edlund round-column vertical drill
910 Gisholt 3½-in. by 36-in. turret lathe

GROUP 11—Exhaust Pipes, Throttles, Feedwater Drums and Superheater Units

1101 Niles 60-in. radial drill
1102 Pond 32-in. triple-geared engine lathe
1103 Reed 18-in. engine lathe
1104 Superheater-unit testing rack
1105, 1106 Hisey-Wolf double-end dry grinders
1107 25-ft. 4,000-lb. jib crane; 1-ton American "Lo-hed" electric hoist
1108 14-ft. jib crane; chain hoist
1109 Lye vat for feedwater-heater tubes

GROUP 12—Brass Manufacturing Department

1201, 1202 Lodge & Shipley 18-in. engine lathes
1203 Lodge & Shipley 20-in. engine lathe
1204, 1211 American 24-in. Fox lathes
1205, 1208 Sidney 18-in. by 6-ft. Monotrol engine lathes
1206 Warner & Swasey No. 4 turret lathe
1207, 1210 American 18-in. Fox lathes
1209 Gisholt 3½-in. by 36-in. turret lathe
1212 Brown & Sharpe No. 6 automatic screw machine

GROUP 13—Turret Lathe Production Department

1301 Cleveland 1¼-in. automatic stud machine
1302 Browne & Sharpe No. 6 automatic tool machine
1303, 1317, 1318, 1319 Jones & Lamson 2¼-in. by 24-in. flat turret lathes
1304 Jones & Lamson 2-in. by 24-in. flat turret lathe
1305 Jones & Lamson 3-in. by 36-in. flat turret lathe
1306, 1314 Warner & Swasey No. 2-A Universal turret lathes
1307, 1310 Warner & Swasey No. 4-A Universal turret lathes
1309, 1312 Warner & Swasey No. 3-A Universal turret lathes
1311 Gisholt 6¼-in. by 42-in. turret lathe
1315 Hisey-Wolf double-end dry grinder
1316 Warner & Swasey No. 4 turret lathe

GROUP 14—Air and Heater Pumps, Fire Doors, Grate Shakers and Reverse Gears

1401, 1402 Micro model FG 18-in. grinders
1403 Air pump test rack
1404 Edlund type 3-D drilling machine
1405 Washing platform
1406 5-ft. by 17-ft. lye vat
1407 Avey 12-spindle No. 3 drill
1408 Hisey-Wolf double-end dry grinder
1409, 1410 2-ton hand-power traveling crane, 23-ft. 6½-in. span with 2-ton electric hoists
1411 Micro model DG grinder
1412 Landis 16-in. by 72-in. cylinder grinder
1413 American 20-in. by 8-ft. high-duty lathe
1414 American 14-in. by 8-ft. high-duty lathe
1415 18-ft. 4,000-lb. capacity jib crane with 2-ton electric hoist
1416 12-ft. 4,000-lb. capacity jib crane with 2-ton electric hoist
1417 Bridgeport 16-in. by 3-in. double-end grinder
1418 Champion 20-in. upright drill
1419 Covel-Hanchett No. 800 vertical grinder with Buffalo blower
1420 Rockwell 21-in. drill press
1421 Edlund drilling machine
1422 Hisey-Wolf 18-in. by 2½-in. double-end grinder
1423 15-ft. radius jib crane; one-ton chain hoist
1424 Foster rotary and lap plate truing machine

GROUP 15—Bolts and Pins

1505 Pels bar shear
1507, 1522, 1523 American 16-in. portable engine lathes
1508 Edlund round-column drilling machine
1509 Special four-spindle bolt turning machine
1510 Bush four-spindle bolt turning machine

1511 Whiton 3½-in. bolt centering machine
1512 Special bolt centering facing and pointing machine
1513 Acme 2-in. bolt pointer
1514 Pawtucket No. 1 Victor nut facer
1515 Landis 2-in. double-head bolt threader
1516 Acme 1½-in. bolt pointer
1517 Detrick & Harvey No. 4 triple-head bolt turner
1518, 1519, 1520, 1521 Sidney 14-in. by 6-ft. engine lathes

GROUP 16—THROTTLE AND REVERSE LEVER

1601 Hendey 24-in. engine lathe
1602 Reed 18-in. engine lathe
1603 Hisey-Wolf double-end dry grinder
1604 Buffalo 20-in. upright drill
1605 Edlund round-column drilling machine

GROUP 17—MISCELLANEOUS WORK

1701 20-ft. 4,000-lb. jib crane; 1-ton American "Lo-hed" electric hoist
1702 Bement Miles 800-lb. steam hammer
1703 Walter Stock adjusting machine
1704 Johnson 36-in. by 36-in. oil-burning blacksmith forge
1706 Watson-Stillman ¾-in. by 2-in. 2-plunger vertical pump

GROUP 18—ELECTRIC SHOP

1801 Bridgeport 16-in. by 3-in. double-end grinder
1802 Barnes 20-in. drill press
1803 Insulating-paint vat for dipping motors
1804 Electric armature baking oven
1805 Electric service 40-in. insulation shears
1806 Underwood 3-in. pneumatic pipe bender
1807 18-in. Hendey engine lathe
1808 Landis 2-in. double pipe and nipple machine

GROUP 19—MANUFACTURING TOOL ROOM

1901 18-ft. 4,000-lb. jib crane; 1-ton chain hoist
1902 Stewart No. 11 oven furnace with Brown control valve and Brown recording pyrometer
1903 Stewart muffle furnace with Brown control valve and Brown recording pyrometer
1904, 1907 Water tanks
1905, 1906 Oil tanks
1908 Stewart No. 3 double-deck furnace with Brown registering pyrometer
1909 Stewart No. 17 rectangular furnace with Brown control valve
1910 Stewart No. 28 oven furnace
1911 Motor-driven turbo-compressor
1912, 1917 Leeds-Northrup temperature recording panels
1913, 1916 Leeds-Northrup automatic temperature control panels
1914 Homo No. 9158 electric furnace, 220 volts, 15 amp., 3.3 kw., 1,800 deg.
1915 Homo electric furnace, 220 volts, 90.8 amp., 20 kw. 1,200 deg.
1918 Brown & Sharpe No. 4-A Universal milling machine
1919 Hisey-Wolf double-end dry grinder
1920 Brown & Sharpe No. 3-B milling machine
1921 Van Norman No. 3 milling machine
1922 Brown & Sharpe No. 2-A milling machine
1923 Brown & Sharpe No. 2 milling machine
1924 Pratt & Whitney vertical shaper
1926 Colburn D-4 24-in. drill press
1927 Gould & Eberhardt 24-in. shaper
1928 Ohio 20-in. shaper
1929 Gould & Eberhardt 14-in. shaper
1930 Champion 20-in. drill
1931 Barnes 20-in. column drill
1932 Gibbs "Little" drill press
1933 Davis No. 1 keyseater

Machining driving-box brasses on draw-cut shapers

1934 Pratt & Whitney 5-in. milling machine
1935 Campbell No. 2 nibbling machine
1936 Racine No. 20-CX shear-cut saw
1937 Whiton 6-in. two-spindle centering machine
1938 Jones No. 4½ arbor and straightening press
1939, 1944 Pratt & Whitney 16-in. Model B lathes
1940 Hendey 16-in. tool-room lathe
1941, 1942 Lodge & Shipley 18-in. engine lathes
1943 Hendey 16-in. engine lathe
1945 Warner & Swasey No. 1-A turret lathe
1946 Ingersoll milling-cutter grinder
1947 Brown & Sharpe No. 2 grinding machine
1948 Brown & Sharpe No. 3 grinding machine
1949 Landis No. 4 Universal grinder
1950 Landis die grinder
1951 Abrasive No. 33 vertical surface grinding machine
1952 Cincinnati 1½-in. plain cutter and tool grinder
1953 Brown & Sharpe No. 13 tool grinder
1954, 1956, 1960 Hisey-Wolf double-end dry grinders
1955 Pratt & Whitney No. 3 bench lathe
1957 Sellers No. 2-A drill grinder
1958 Sellers 3-in. drill pointing machine
1959 Oliver No. 51 3-in. drill grinder
1961 Sellers No. 1-A tool grinder
1962 Sellers No. 1 Universal tool grinder and shaper
1963 Bridgeport No. 5-F grinder
1964 Gisholt Universal tool grinder

GROUP 20—MACHINE TOOL REPAIR GROUP

2001 Betts 54-in. by 14-ft. planer
2002 Racine No. 2-C power hack saw
2003 Betts-Bridgeford 30-in. geared-head engine lathe
2004 American 18-in. engine lathe
2005 Hisey-Wolf double-end dry grinder
2006 American 14-in. engine lathe
2007 Whiton 6-in. 2-spindle centering machine
2008 Edlund round-column drilling machine
2009 American 5-ft. plain radial drill
2010 Ohio 24-in. Dreadnaught shaper
2011 Bridgeport No. 5 tool grinder
2012, 2013 20-ft. 4,000-lb. jib cranes; 1-ton American "Lo-hed" electric hoists

GROUP 22—TIN AND JACKET WORK

2201 Pels double-end punch and shear
2202 Atkins 12-in. by 4-in. metal band saw
2203 Rockwell 21-in. drill press
2204 Hisey-Wolf double-end dry grinder
2205 Thomson spot welder
2206 Peck, Stow & Wilcox 98-in. cornice brake
2207 Niagara 96-in. squaring shears
2208 Peck, Stow & Wilcox 32-in. squaring shears
2209 Peck, Stow & Wilcox 36-in. by 36-ft. shear
2210 Lenox throatless rotary shear
2211 Dreis & Krump 96-in. cornice brake
2212 Thomson spot welder
2213 Niagara No. 7 geared press
2214 Peck, Stow & Wilcox 42-in. No. 142 shear
2215 Peck, Stow & Wilcox 36-in. No. 137-C shear
2216 Niagara No. 4 geared press
2217 Niagara No. 101 press

GROUP 24—PIPE WORK

2401 Landis 8-in. single-head pipe threading and cutting machine
2402 Peters 12-in. abrasive pipe cutter
2403 Murchey 4-in. pipe cutter
2404 Bignall & Keller No. 3 pipe cutter
2405, 2406 Landis 1¼-in. double-head pipe and nipple threading machines
2407, 2408 Landis 2-in. double-head pipe and nipple threading machines
2409 Williams 4-in. single-head pipe and nipple threading machine
2410 3-in. extra-heavy rotary pipe bending machine
2411, 2414 Pipe forges
2412, 2415 Quenching tanks
2413, 2416 Pipe bending tables
2418, 2422 18-ft. jib cranes, 4,000-lb. capacity; 1-ton electric hoists
2419, 2420, 2421 Babbitt furnaces

GROUP 25—PHYSICAL TESTING LABORATORY

2501 Southwark 5¼-in. by 1¼-in. by 2-in. hand pump
2502 Ingersoll-Rand Type 15 motor-driven air compressor
2503 Southwark 1,000,000-lb. Universal testing machine
2504 Scott horizontal fabric tester
2505 Hisey-Wolf double-end dry grinder
2506 Southwark 60,000-lb. testing machine
2507 Edlund round-column drilling machine
2508 20-ft., 4,000-lb. capacity jib crane; 1-ton American "Lo-hed" electric hoist

GROUP 26—CHEMICAL LABORATORY

2601, 2602 Edlund 3-D drilling machines
2603 Wicaco oil groover

BLACKSMITH SHOP *

1 42-in. cold-saw cutting-off machine
1 18-in. double-end dry grinder
1 No. 5 wet tool grinder
1 Pneumatic stock bender
1 1,000-ton hydraulic forging press
1 Walter Stock adjusting machine
1 8-ft. 6-in. by 15-ft. car bottom annealing furnace
1 7-ft. by 9-ft. 6-in. double-chamber hammer furnace
3 3-ft. by 5-ft. furnaces
4 2-ft. by 3-ft. furnaces
1 2-ft. by 4-ft. furnace
1 5-ft. by 6-ft. furnace
3 100-lb. helve hammers
1 4,000-lb. steam hammer
2 2,000-lb. steam hammers
1 1,100-lb. steam hammer
23 Coal forges
2 Oil forges
1 1,000-amp., 75-kw., motor-generator set
1 No. 4 Oxygraph cutting machine

* The locations of these facilities are not shown on the drawings.

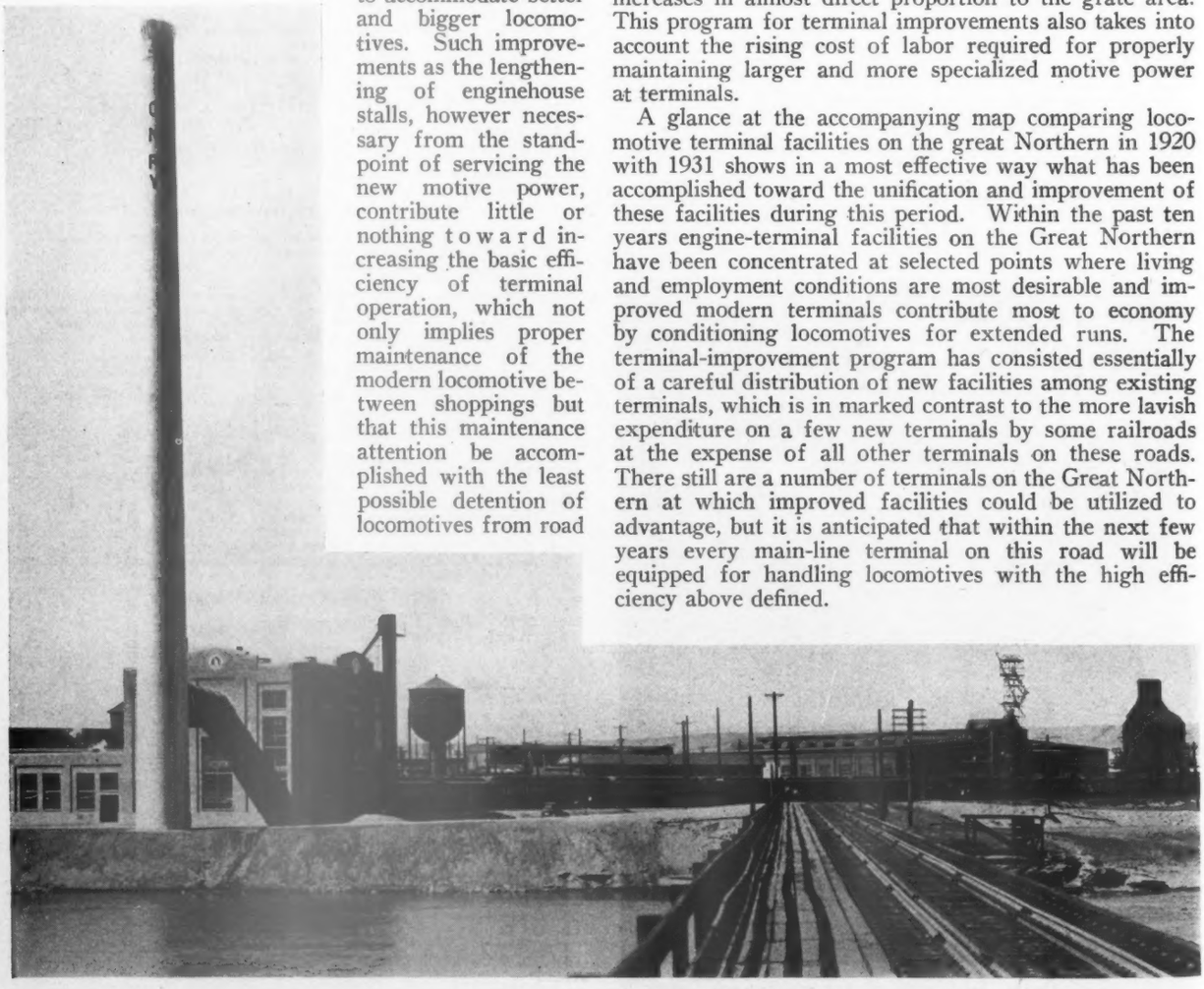
Modernizing Locomotive Terminals On the Great Northern

Main line power handled at 18 fewer enginehouses than in 1920 —Improvements at present terminals show substantial savings

PARALLELING the advent of more modern locomotives, extended locomotive runs, use of less expensive fuel and other desirable motive power developments, there must be a corresponding modernization in locomotive terminal facilities to realize the full benefit from these improvements in motive-power practice. While some roads have allowed their terminal facilities to lag seriously behind development of the locomotive, there have been many notable exceptions in the form of new terminals constructed in the last few years to meet changing motive-power conditions. But no railroad has adopted a more comprehensive or consistent program in respect to locomotive terminal improvements than the Great Northern.

An outstanding feature of the Great Northern's locomotive terminal program is the fact that it is not confined to a mere enlargement or multiplication of existing facilities required to accommodate better and bigger locomotives. Such improvements as the lengthening of enginehouse stalls, however necessary from the standpoint of servicing the new motive power, contribute little or nothing toward increasing the basic efficiency of terminal operation, which not only implies proper maintenance of the modern locomotive between shoppings but that this maintenance attention be accomplished with the least possible detention of locomotives from road service and with the lowest possible fuel and labor cost at terminals. The program for terminal improvements on the Great Northern has taken into account the opportunity for economy in connection with the large quantities of fuel ordinarily consumed at terminals, not only for general purposes about the terminal but on locomotives while building fires or standing under steam at terminals. In this connection it should be borne in mind that the increase in grate areas with the advent of the more modern locomotives, while making for fuel economy on the road, has greatly increased the coal consumption at terminals since it has been found that this increases in almost direct proportion to the grate area. This program for terminal improvements also takes into account the rising cost of labor required for properly maintaining larger and more specialized motive power at terminals.

A glance at the accompanying map comparing locomotive terminal facilities on the great Northern in 1920 with 1931 shows in a most effective way what has been accomplished toward the unification and improvement of these facilities during this period. Within the past ten years engine-terminal facilities on the Great Northern have been concentrated at selected points where living and employment conditions are most desirable and improved modern terminals contribute most to economy by conditioning locomotives for extended runs. The terminal-improvement program has consisted essentially of a careful distribution of new facilities among existing terminals, which is in marked contrast to the more lavish expenditure on a few new terminals by some railroads at the expense of all other terminals on these roads. There still are a number of terminals on the Great Northern at which improved facilities could be utilized to advantage, but it is anticipated that within the next few years every main-line terminal on this road will be equipped for handling locomotives with the high efficiency above defined.



New Great Northern power plant and enginehouse addition at Great Falls, Mont.

All expenditures for these improvements on the Great Northern have been directed in accordance with a general plan for the elimination of any terminals that could be dispensed with by an extension of locomotive runs or consolidation of facilities. Other terminals have been improved to incorporate modern features of construction and layout, a striking example being the new Interbay locomotive terminal at Seattle, Wash., where all shop facilities on the west coast are concentrated. This is a 24-stall enginehouse with a power plant containing two oil-fired 250-hp. Babcock & Wilcox bent-tube boilers, supplying direct steam to all locomotives. No fires are lighted while locomotives are in the house and no heating system or smoke jacks are required on this account. As an indication of the fuel economy resulting from this method of operating the terminal, it is observed that expenditure for all fuel oil consumed has averaged about $2.15 per locomotive turned, the shop and other general steam requirements outside the enginehouse being estimated at approximately one-half of the total boiler output.

The Interbay terminal illustrates a type of construction which has been developed as a standard for all new structures or additions to present main-line enginehouses on the Great Northern. This comprises a monitor roof of timber construction supported on 10-in. by 10-in. timber posts. Monitor sash are wood but the outer and end walls have steel sash which were found practicable owing to elimination of all smoke and stack gases in the house. This, together with an interior coating of aluminum paint, produce an exceptionally well lighted interior. The outside, end and partition walls in these new standard enginehouses are of brick. Locomotive doors are wood with steel framework hinged on cast-iron pillars. At Interbay, a wood floor was laid on account of the low cost of timber on the coast but in all other new houses and in a number of the older houses, concrete floors are being laid. The stall length of these new enginehouse sections varies with the requirements for size of locomotives to be handled, but this does not alter the general type of construction. At Interbay, the stall length is 116 ft. and in the new addition to the enginehouse at Great Falls, Mont., and other main line terminals, the stall length is 134 ft. as shown in the accompanying cross-sectional drawing.

While the gradual extension of locomotive runs has been a determining factor in the rearrangement of locomotive terminals, the substitution of coal for oil fuel and utilization of low priced coal mined locally, are now equally important factors in respect to the rehabilitation of these terminals. The increased use of coal on locomotives has added a considerable burden to terminal operations, not only in respect to coal handling but cinder disposal, since the available western coals have a high ash content. During the past ten years the Great Northern has built seven steel coaling stations. A majority of these new coaling plants have been erected to supersede frame coaling stations which, although mechanically operated, had become expensive to maintain and inadequate in capacity. At the larger terminals the practice is to install all-steel superstructures of 500 tons overhead bin storage and a hoisting capacity of 75 tons per hour. This is obtained with balanced buckets and a mechanically reversing hoist driven by a 15-hp. motor, the low current consumption required for this type of equipment being one of the factors contributing to the operating savings obtained from improved coaling facilities.

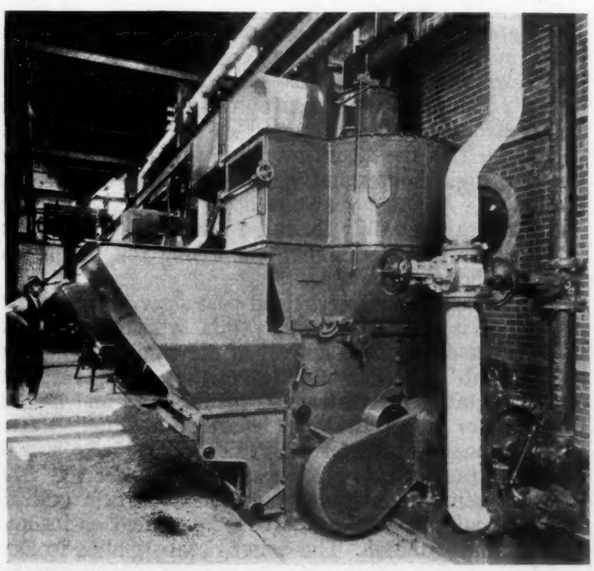
It has been found on the Great Northern that coaling stations of this type with the steel superstructure can be built more economically than with concrete and, if necessary, can be moved from one terminal location to another to meet a change in operating conditions.

Originally all locomotive cinder-handling facilities on the Great Northern were of the familiar hand shovel type with a depressed track for the cinder cars into which the ashes were shoveled. There are now seven locomotive terminals on the Great Northern having mechanical equipment for handling cinders. Most of these facilities are designed to serve several locomotive tracks, every multi-track unit being equipped with cast-iron hoppers of 100 cu. ft. capacity and undercut gates between adjacent tracks served and a bucket of 50 cu. ft. capacity running under these hoppers. The ash bucket is entirely automatic in its operation, being controlled by electric push-button switches between the tracks so that the same men who dump locomotive fires and empty the ash pans can hoist these cinders into an adjacent car without additional labor. The labor savings accomplished by each of these mechanical cinder plants depends on the number of tracks served and locomotives handled, but for a typical three-track installation is averaging $4,000 per year. There is also an indirect saving accomplished in reduced detention to locomotives passing over a multi-track cinder plant into the enginehouse because of the increased number of locomotives that can be accommodated at the same time.

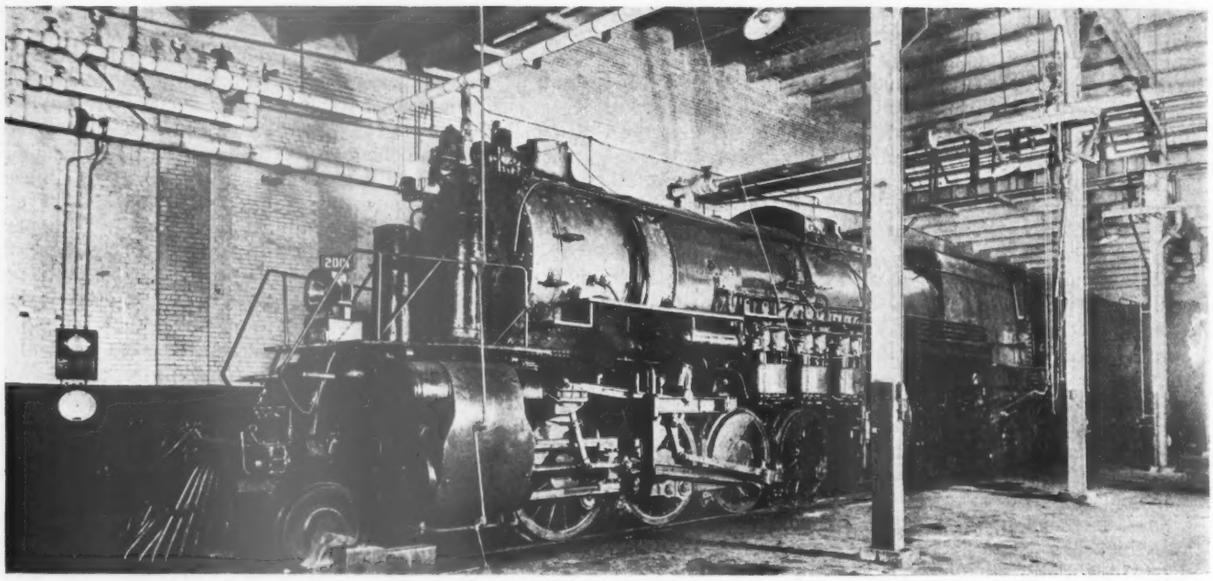
Improved Boiler Plants an Important Objective

Ten years ago the power plants at locomotive terminal on the Great Northern had stationary boiler equipment consisting very largely of old locomotive or horizontal return-tubular boilers of limited capacity. They were probably no worse than on many other roads where there was little or no appreciation of the large quantities of fuel usually wasted by these antiquated facilities, or of the handicap to satisfactory terminal operation because of their inadequate capacity.

In recent years some roads have undertaken to improve this situation by the electrification of terminals. This has involved the installation of motor-driven compressors and other shop tools where required and electric stack-blower fans in place of the usual steam blower line. Electric current rates that on their face appear attractive are usually offered by the public utility com-



Unit pulverizers adapted to burning low-cost screened coal in Great Northern locomotive terminal power plants

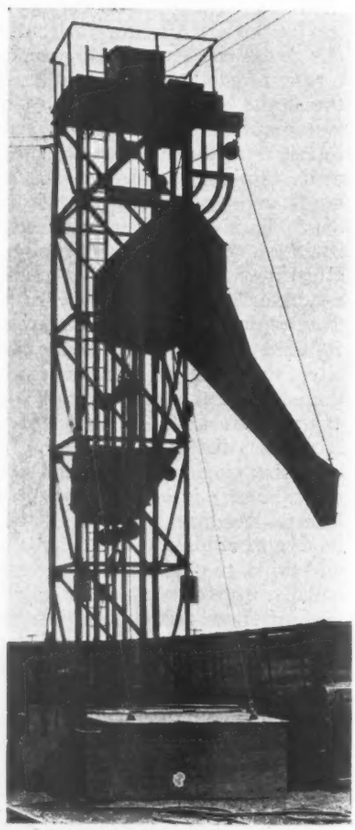


pany as an inducement but often prove expensive for the railroads on account of certain premiums that must be paid for peak-load requirements. Furthermore, at all terminals on the Great Northern the heating load is an important consideration, as heat, not only in the enginehouse but for adjacent shop and station buildings, coach yards, etc., is required for at least nine months of the year. To make an investment in electrically operated equipment and purchase current throughout the entire year in order to close down and disrupt the organization of a stationary boiler plant for a few months was not considered economical, particularly where the opportunity exists, as on this road, to purchase locally mined coal suitable for stationary boiler use at a low price. The policy on the Great Northern is to take advantage of this situation through improved power plants.

The first important step in this direction on the Great Northern was the construction several years ago of a new boiler plant at Minot, N. D., designed to utilize the lignite coal that is mined locally. This plant consists of three Edgemoor boilers of 250 hp. capacity each, with chain-grate stokers and forced draft. Originally this plant was intended to furnish steam at 150 lb. pressure for the operation of an engine-generator set as well as the steam required for drafting engines in the enginehouse and heating all of the terminal buildings. About a year ago however, the boiler pressure was raised to 175 lb. and a direct steaming system installed to serve 18 stalls, comprising the newer section of the enginehouse.

All of the larger freight and passenger power turned at Minot is now operated by this system, locomotive fires being dropped on arrival at the cinder pit and not ignited until the locomotive leaves the enginehouse. All steam required for resteaming locomotives and holding them under steam awaiting departure is supplied from the stationary boiler plant. The greatest economy in the operation of this system at Minot is derived from the difference in stationary power-plant fuel and the cost of coal that would otherwise be burned on locomotives at the terminal. The eastern coal supplied to locomotives at this point costs about $3.75 per ton at Superior, Wis., and must be hauled nearly 500 miles to Minot, while lignite coal burned in the stationary boilers

Typical interior of new standard enginehouse construction on Great Northern showing high pressure locomotive steam supply line from power plant with meter and low pressure connections



Multi-track mechanical cinder plant at the Williston (N.D.) terminal, typical of several installations that are making a substantial labor saving and expediting locomotive handling

costs 75 cents a ton at the mines which are less than 75 miles from Minot. While this lignite coal is inferior in heat value to the locomotive coal, the stationary boilers in which it is burned are operated at a much higher rate of efficiency than could possibly be obtained on locomotives standing in the enginehouse so that this difference in the cost of fuel per ton represents approximately the actual saving for each locomotive turned. In addition to this saving, there is an appreciable reduction in the amount of fuel required to heat

the enginehouse because of the elimination of open smoke jacks through which a considerable amount of heat escapes in cold weather.

New Power Plants Typify Best Modern Construction

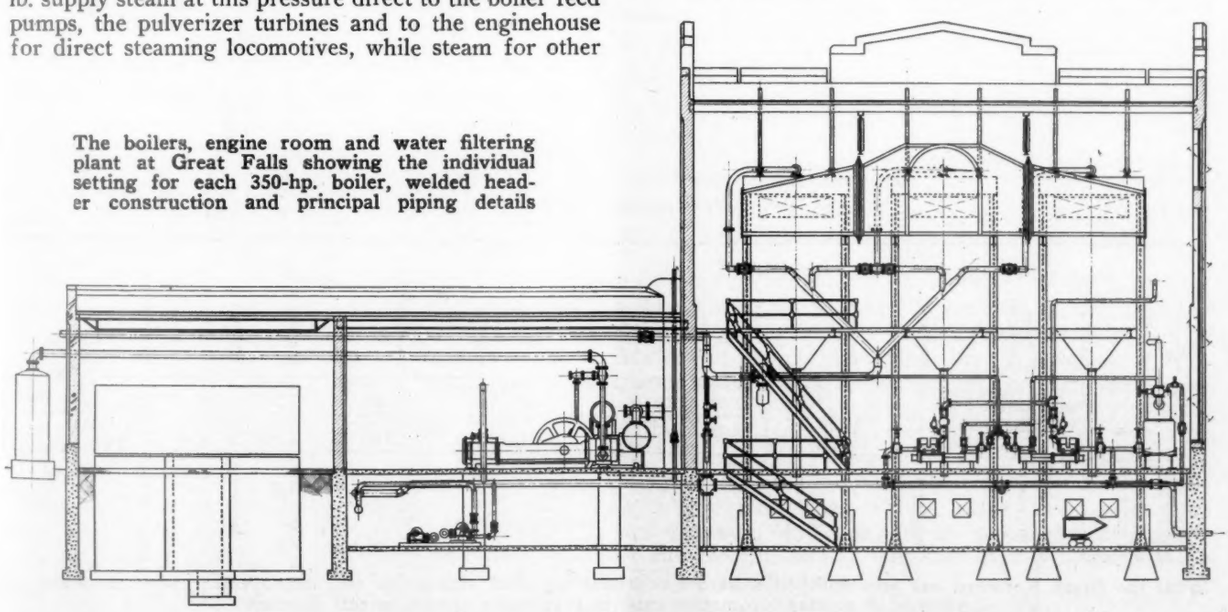
This year the Great Northern is building three modern power plants, at terminals where cheap stationary power-plant coal is available, to replace horizontal return-tubular and old locomotive boilers in which it has been necessary to burn fuel oil to develop the required output. While the highest standards of boiler efficiency have been aimed at the capital expenditures involved have been moderate. The largest of these power plants has just been completed at Great Falls, Mont., to serve a 36-stall enginehouse, the adjacent locomotive and car shops and to furnish steam for heating these buildings as well as the passenger station, freight depot and division offices at some distance (across the Missouri River bridge) from the locomotive terminal. Steam-driven equipment in the power house includes an air compressor, turbine pumps for a water filtering plant, duplex boiler feed pumps (outside packed) and turbine-driven unit coal pulverizers for supplying the boilers with pulverized coal. No electric generating equipment is provided as the electric current requirements are purchased under contract from near-by hydro-electric plants. For supplying the steam required at this terminal, the new power plant is equipped with three 350-hp. Bros-Wetherbee boilers designed to burn pulverized coal from Strong-Scott unit pulverizers. The boilers each have individual settings with Liptak air-cooled walls and a combustion space ample for developing over 300 per cent rating.

Natural draft sufficient for developing this rating from two boilers in operation at the same time is provided by a 225-ft. concrete stack. Instruments for governing the efficient operation of each boiler include a Republic integrating and recording steam flow meter with CO_2 and stack-gas temperature recording on a single chart, with a set of draft gauges mounted on the same panel. The stack damper control on each boiler is of the automatic type manufactured by the Engineer Company. The boilers have Marion soot blowers with seven blower heads to each boiler. The power-plant piping involves two pressure systems, the boilers carrying 250 lb. supply steam at this pressure direct to the boiler feed pumps, the pulverizer turbines and to the enginehouse for direct steaming locomotives, while steam for other auxiliaries, heating, etc. is taken from a low-pressure header supplied through the reducing valve arrangement illustrated herewith. The accompanying cross-sectional and elevation drawings of the power plant and boilers show the general arrangement and construction of this equipment, particularly the design of boilers and principal piping details. This is of all welded construction with a special header arrangement for equalizing steam flow from each boiler. All steel fittings with welded-in necks and welded-in elbows were employed in this construction, which was installed by the Railway Engineering Equipment Company. All valves, except the Fisher pressure-reducing valves and a Hancock cast steel cone-seated valve in the pressure-reducing by-pass, were furnished by the Crane Company, Series 30XN cast-steel valves being employed in the higher-pressure steam mains and boiler feed lines. The coal- and ash-handling facilities are both of the vertical-conveyor type, with a 125-ton coal storage bin in the boiler room. A motor-operated weigh-lorry distributes coal from this bin to each of the three unit pulverizers.

Fuel Cost Reduced at One Terminal from $5,000 to $1,500 a Month

This new power plant supersedes an old boiler plant typical of many terminal installations still in use, comprising three horizontal return-tubular boilers of 150-hp. capacity each and five locomotive boilers, all oil-fired and consuming fuel oil at the average rate of about 1,400 lb. an hour. In addition to this, the new power plant supersedes a large oil-fired locomotive kept under fire in the enginehouse as a temporary expedient for supplying the steaming system pending construction of the new power plant. The total fuel oil consumption at this terminal has been costing the railroad about $5,000 per month which will now be reduced to a coal consumption of less than 50 tons per day at a price of $1.00 per ton.

The coal now being burned is mined near Great Falls by a subsidiary company. As this coal is intended for use in pulverizers it is screened out of the locomotive coal furnished to the railroad by the same company which tends to improve this coal for locomotive use. While the coal supplied is of relatively low heat value, the power plant is equipped to realize the utmost effi-



The boilers, engine room and water filtering plant at Great Falls showing the individual setting for each 350-hp. boiler, welded header construction and principal piping details

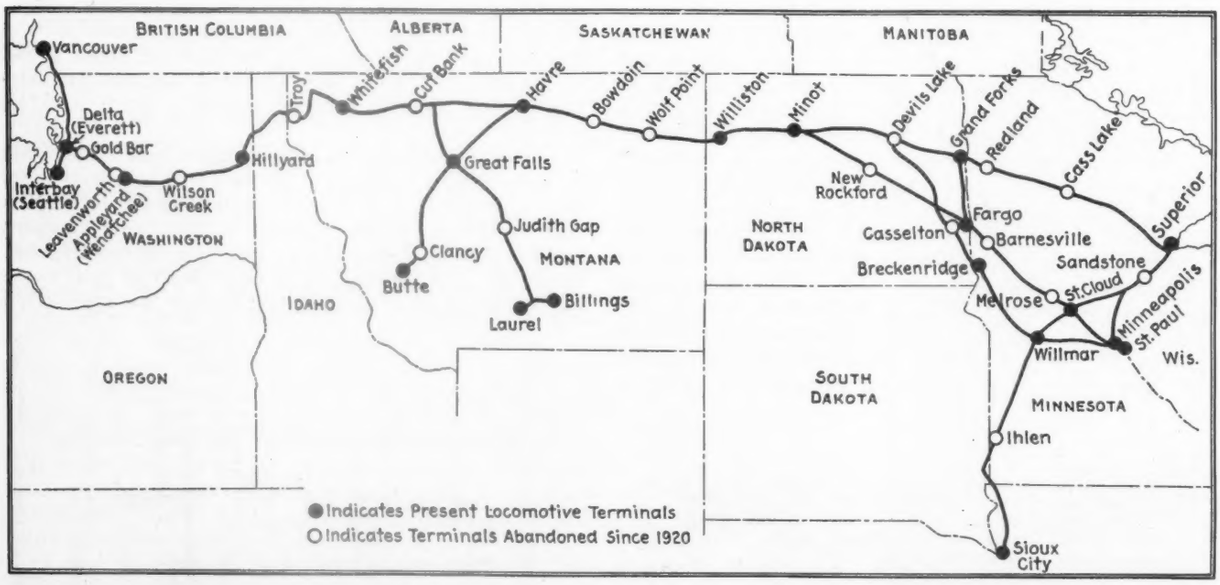
ciency from this grade of coal. In an initial run stack gas temperatures of approximately 500 deg. and a CO_2 content of more than 17 per cent were observed.

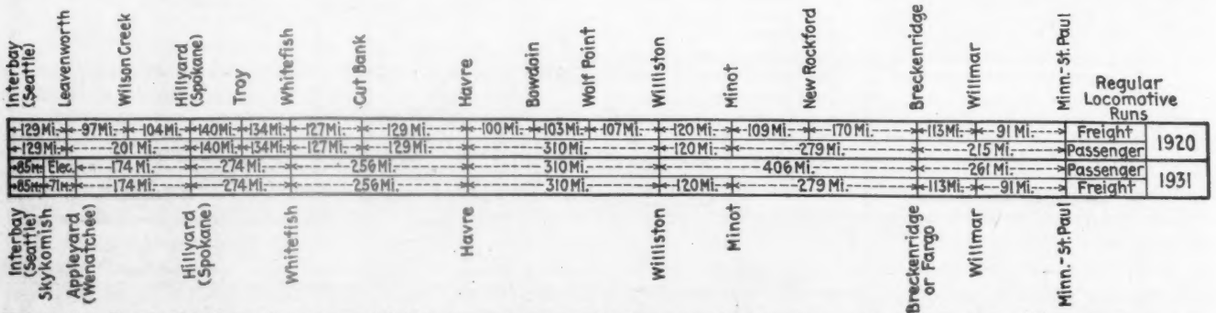
The direct-steaming system in the enginehouse to be supplied by this power plant with steam at 250-lb. pressure, extends over 18 stalls which includes an 8-stall addition of the new standard construction without smoke jacks and ten adjoining stalls which are sufficient for handling all of the larger locomotives turned at this terminal. A Cochrane indicating, recording and integrating flow meter is installed in the direct-steam supply line where this enters the enginehouse as a guide in the operation of this system to avoid unnecessary peak loads and record the total steam used. The entire power plant project at Great Falls cost the railroad less than $200,000, exclusive of the equipment already on hand, such as air compressors, etc., which were utilized.

Two other locomotive-terminal power plants now under construction on the Great Northern are located at Whitefish, Mont., and Williston, N. D. Both of these plants conform to the same high standard of design and construction as that above described, although they are of smaller capacity than the Great Falls power plant. At the Whitefish terminal, three boilers of 250 hp. capacity each, furnished by the Puget Sound Machinery Depot, are being installed. These are designed for burning pulverized coal and are of the same type of construction as that employed at Great Falls, which will permit operation at 300 per cent rating with the same degree of efficiency. Screened coal from the Great Falls district will also be utilized, but at a somewhat higher cost on account of the longer freight haul involved. However, this coal will move against the direction of heavy tonnage so that its actual cost to the railroad will be small in comparison with oil fuel now used at this terminal. There are no shops at Whitefish and auxiliary steam-driven equipment is considerably less than at Great Falls so that the principal economy to be derived from the efficient utilization of this low cost coal will be obtained by means of the direct steaming system in the enginehouse. This system embraces 21 stalls including a 7-stall addition of the new standard section 134 ft. long.

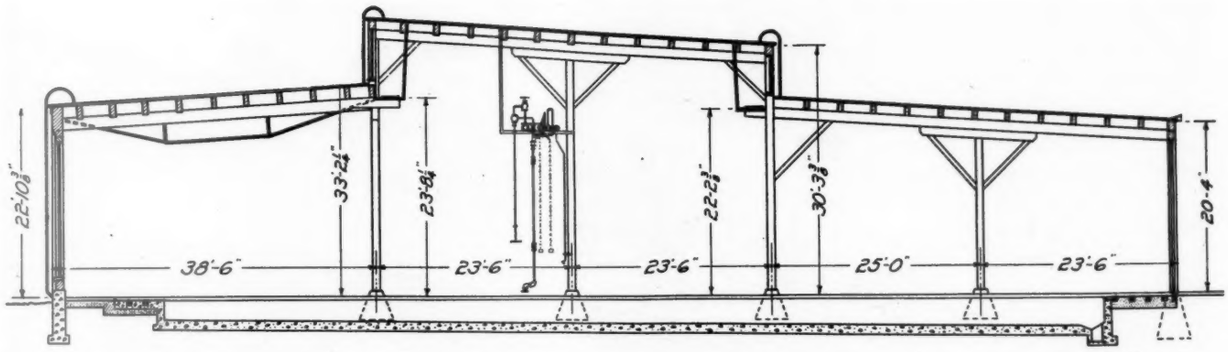
As all of the passenger locomotives, and main line freight power now operating out of the Whitefish terminal are burning oil costing over $1.00 per barrel, the economy of utilizing cheap coal burned under the most efficient conditions in place of the oil fuel that would otherwise be burned on locomotives at a less efficient rate of evaporation, is obvious. In addition to this economy, the heating load in winter will not only be reduced by closing all smoke jacks in the direct steaming section of the enginehouse but as this has been one of the principal demands on the present oil-fired boilers, such steam as will be still required for heating purposes can be supplied at a much lower cost per pound.

The new power plant at Williston, N. D., while having the same rated capacity as Whitefish, is of quite different construction, being equipped with three Edgemoor straight-tube boilers and chain-grate stokers. These stokers, however, will each have a forced-draft fan and the combustion space below the flues, width of

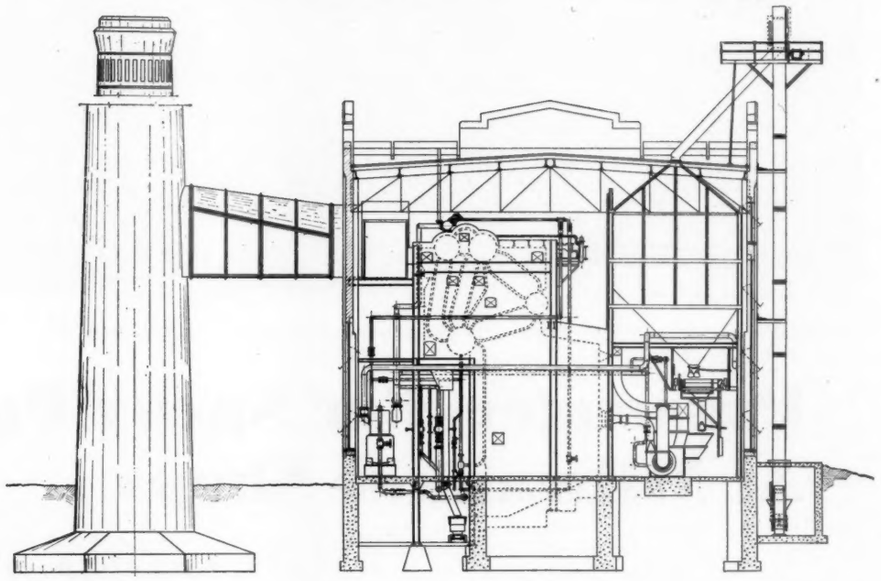



Interbay (Seattle)
Leavenworth
Wilson Creek
Hillyard (Spokane)
Troy
Whitefish
Cut Bank
Havre
Bowdoin
Wolf Point
Williston
Minot
New Rockford
Breckenridge
Willmar
Minn.-St. Paul
Regular Locomotive Runs
129 Mi. 97 Mi. 104 Mi. 140 Mi. 134 Mi. 127 Mi. 129 Mi. 100 Mi. 103 Mi. 107 Mi. 120 Mi. 109 Mi. 170 Mi. 113 Mi. 91 Mi. Freight 1920
129 Mi. 201 Mi. 140 Mi. 134 Mi. 127 Mi. 129 Mi. 310 Mi. 120 Mi. 279 Mi. 215 Mi. Passenger
85m Elec. 174 Mi. 274 Mi. 256 Mi. 310 Mi. 406 Mi. 261 Mi. Passenger 1931
85m 71m 174 Mi. 274 Mi. 256 Mi. 310 Mi. 120 Mi. 279 Mi. 113 Mi. 91 Mi. Freight
Interbay (Seattle) Skykomish
Appleyard (Wenatchee)
Hillyard (Spokane)
Whitefish
Havre
Williston
Minot
Breckenridge or Fargo
Willmar
Minn.-St. Paul

What the Great Northern has accomplished toward locomotive terminal unification and improvement with resultant extension of regular locomotive runs is graphically shown in this diagram



Cross section of typical new standard Great Northern enginehouse construction with combined blow-down, filling and steaming connections to locomotive shown



Cross section of Great Falls power plant showing coal handling arrangement and ample combustion chamber with water tube back and air-cooled walls discharging heated air in the duct to the unit pulverizers

stoker, etc., are of ample dimensions for developing a 200 per cent rating either with screening from the Montana mines or with lignite coal. The lignite, if used, would be of the same grade as now utilized at the Minot terminal. In either case the cost of coal to be utilized in the new power plant will be relatively low compared with either eastern coal or oil fuel. The number of enginehouse stalls equipped for direct steaming locomotives at this terminal will be 19, which is sufficient for handling the larger motive power in active service.

Additions in Main-Line Engine-Terminal Facilities Since 1920

	1920			1931				
Location	No. stalls	Coaling station	Hot water wash and fill	No. stalls	Coaling station	Hot water wash and fill	Direct steam	Mech'l cinder plant
Interbay (Seattle)	20	.....	....	24	.....	Yes	Yes	....
Appleyard (Wenatchee) ..	3	.....	....	24	250 tons Timber	Yes	....	....
Hillyard	28	500 tons Timber	....	34	500 tons Timber	Yes	....	....
Whitefish	30	100 tons Incline	....	37	500 tons Steel	Yes	Yes	....
Great Falls.....	36	500 tons Timber	....	38	500 tons Steel	Yes	Yes	3 tracks
Havre	31	300 tons Timber	Yes	30	500 tons Steel	Yes	....	....
Glasgow ..... (between Bowdoin and Wolf Point)		No terminal			No terminal			2 tracks for cleaning fires on through runs
Williston	30	274 tons Incline	....	32	500 tons Steel	Yes	Yes	4 tracks
Minot	36	400 tons Timber	....	38	400 tons Timber	Yes	Yes	....
Grand Forks	20	500 tons Timber	....	38	500 tons Timber	Yes	....	2 tracks
Fargo	..	.....	....	16	150 tons Timber	....	....	....

	1920			1931				
Location	No. stalls	Coaling station	Hot water wash and fill	No. stalls	Coaling station	Hot water wash and fill	Direct steam	Mech'l cinder plant
Breckenridge	31	250 tons Incline	Yes	32	250 tons Incline	Yes	....	....
Wilmar	36	200 tons Incline	....	36	500 tons Steel	Yes	....	....
St. Cloud	5	500 tons Incline	....	24	500 tons Incline	Yes	....	....
Minneapolis	25	120 tons Incline	....	34	500 tons Steel	Yes	....	....
St. Paul	47	400 tons Timber	....	25	500 tons Steel	Yes	....	....
Superior	33	250 tons Incline	....	33	250 tons Incline	Yes	....	....

Improvements at Small Terminals

In addition to the more important terminal improvements above described, a host of less spectacular but no less sound improvements have been accomplished at locomotive terminals on the Great Northern during the past ten years. At a number of smaller terminals where eastern coal is burned, the power-plant situation has been improved in various ways. For instance, at the Willmar (Minn.) terminal the stationary boilers have been equipped with Strong Scott unit pulverizers, motor-driven, which has not only increased their capacity to the desired output, but has greatly improved the efficiency of this terminal.

(*Concluded on page 302*)

Exhaust stack arrangement for four DeVilbiss canopy-type car exhausts installed at the Milwaukee passenger-car paint shop

Passenger-Car Spray Painting At Milwaukee Shops

Canopy-type exhaust hoods effect an actual pay-roll saving of $12,000 to $15,000 per annum

THE greatest single labor-saving device installed in recent years" is the description accorded the four canopy-type exhaust hoods now used in spray painting passenger train cars at the Milwaukee (Wis.) shops of the Chicago, Milwaukee, St. Paul & Pacific. When this equipment, furnished by the DeVilbiss Company, Toledo, Ohio, was installed in March, 1930, at a complete installation cost, including material, labor, changes in floor construction, heating system, sprinkler equipment, etc., of $37,342, a possible saving of $9,300 annually in labor was estimated. The actual pay-roll saving made as of March 17, 1931, due to the use of the spray hoods, was $59.07 per working day, or $12,286.56 yearly, for 52 weeks at four days each, or $15,358.20 yearly for 52 weeks at five days each. The details of how this saving was made are shown in Table I, which indicates a potential pay-roll saving of $3,000 to $6,000 greater than the estimated saving (depending on the number of working days in the year).

The stationary canopy-type exhaust hoods, illustrated, were installed on four tracks in one end of building No. 24 at the Milwaukee passenger-car shops. The canopies are constructed of heavy-gage sheet metal which is spot-welded to angle-iron frames. Heavy-gage galvanized sheet metal is used in the stacks and caps, the stacks being guyed to the roof with cable and turnbuckles.

The multi-blade fans are 42 in. in diameter and are driven by 5-hp. Allis-Chalmers motors through V-belts. The motors and fans are ball-bearing and require little attention. Fan blades are of aluminum and are mounted on the roof with a housing over the motors and belts. Motors and fans are mounted on a frame, making a complete unit, which, in turn, rests on legs bolted to the roof. Each fan has a capacity of 18,000 cu. ft. per min., and five are used on each canopy. Each canopy is 85 ft. long, giving a fan spacing of 17 ft.

Six Benjamin, 300-watt, vapor-proof lights are used on both sides of the canopy, spaced approximately 6 ft. apart. These are controlled by switches in groups of four, allowing the operator to use only the lights where he is spraying.

A double set of Grinnell sprinklers are used, one set for the canopy and one hanging under the inner canopy to protect the work. The heads are silica-bulb, two rows on top and two rows on the bottom, spaced 6 ft. apart.

A Buffalo pressure blower, driven by a 5-hp. motor, is located on the beams above the canopy, forcing air down through a duct to the concrete floor ducts. These are 12 in. wide and 23 in. deep with walls approximately 6 in. thick. Sufficient air pressure is maintained to force air upward through the floor slots past the sides of the car at velocities up to 500 ft. per min., as required.

In action, the blower air forms a curtain between the operator and the work. This prevents any rebound of spray, since the air stream is close to the side of the car and the operator sprays through the stream. The air starts the fumes upward, carrying them up to the canopy,

thus combining a push from the blower with a pull from above.

Referring to the drawing, the action of this system is clearly illustrated at the left for exterior spray painting. An air current, indicated by the arrows, flows from the floor slots upward between the painter and the car side, the spray-gun nozzle passing through this air curtain, which protects the spray operator from all fumes. These are carried instantly into the lower opening of the canopy and from there to the exhaust pipe and the atmosphere under the action of the powerful motor-driven fan. For painting a car interior, as shown at the center in the illustration, the input air from the floor slot is deflected into the car at the windows by the deflector fin *A*, the hinged section *B* being closed. The air stream, as deflected by this fin, flows through the interior of the car and out through opposite side windows, there joining air from the floor slot on that side of the car and being exhausted through the stack, as indicated.

Direct ventilation is provided for spray painting car roofs by opening the hinged sections *C* and closing sections *B*, as shown at the right in the illustration. The input air from the floor slots is passed over the car roof, upward into the canopy through the opening and then directly through the stack to the open air.

The weight of each canopy with the fans, motors, stacks, etc., that would be carried on the building is approximately 30,000 lb., but as this is spread over a space nearly 20 ft. wide and 85 ft. long, no reinforcing of the building was necessary.

The purpose of canopy-type exhaust hoods in the Milwaukee passenger-car shop is to permit the spray painting of equipment without attendant fire and health hazards, and the entire design, construction and installation have received the approval of the Underwriters and the State Health and Labor Departments.

Spraying Force vs. Brushing Force

The present spray-booth force at Milwaukee shops (as of March 17, 1931) was built up by the assignment of three sprayers from the former night spraying force, the transferring of two sprayers from the sash and door spraying force, and the hiring of three new expert sprayers. An expert main sprayer, capable of supervising and instructing others, was also hired. The tractor driver is a former night sprayer, and the three helpers are painters' helpers or washers transferred to the spray booths. Of the 13 men involved, nine are former employees transferred to the booths and four are men hired new.

A comparison of the former painting and spraying force with the present spraying force (Table I) shows that only three additional sprayers were added to offset 15 painters laid off. This means that paint can be applied on a car about five times quicker by spraying than by brushing, a conclusion further borne out by the fact (established by time studies) that a 70-ft. coach, for example, can be varnished by spray in about two hours, whereas 10 hours were allowed for brushing.

Former Painting Method—Assigned Car Output of Booths

Prior to the operation of the spray booths, most of the so-called rough painting work on the cars (roof, bottom, trucks, etc.) was sprayed either in the shop at night or in the shop yard during the day. The finer work, such as colors and varnishes, was brushed. Since the operation of the spray booths, it may be said that both the rough and finer work is now sprayed. The present exception is certain interior work on sleepers, etc., which is still brushed. Cars are, of course, still puttied, sanded, primed and touched up by hand.

The outside lettering on cars (except the gold leaf) is now sprayed instead of brushed. However, this work is not done under the spray canopies and has no connection with them and is, therefore, not covered in this study.

To obtain an output of three cars a day from the coach shops, it is necessary for the spray booths to handle 12 cars a day; that is, apply three first-coat body colors, three second-coat body colors, three first-coat outside varnishes and three second-coat outside varnishes. The other painting work of the cars is generally divided into four parts also, and handled at the same time that the outside body coats are being applied. In other words, each car must enter the spray booths four times.

To determine the actual performance of the spray booths, a study was made of them from January 13, 1931, to February 26, inclusive, a period of 26 working days, and the results obtained from this study recorded. The study was, without doubt, slightly unfair to the spray booths, inasmuch as during that period the booths were in what might be called an experimental stage. The sprayers were learning how to handle their guns properly, how much material to apply to surfaces and how to apply it, how to get clean jobs, how to cut in, etc. The spray-booth supervision, on its part, was trying various methods of handling the work, regulating the air drafts, etc., so as to obtain the best methods and the correct spraying procedure. Furthermore, the car

Table I—Actual Pay-Roll Saving, Due to the Operation of Spray Booths, from December 15, 1930, to March 17, 1931

Labor Cost Prior to the Operation of Spray Booths (Dec. 15, 1930, and Before)					Labor Cost After Operation of Spray Booths (As of March 17, 1931)				
Occupation	Work	No. of men	Hourly rate	Daily cost	Occupation	Work	No. of men	Hourly rate	Daily cost
Painters	Brush work on cars such as colors and varnishes, etc.	15*	$.80	$96.00	Main sprayer	Leadman in spray booth	1	$.90	$7.65**
Helper	Carry paint from mixing room to painters.....	1	.57	4.56	Sprayers	Spray roofs, bottoms, trucks, colors, varnishes, etc., on cars in spray booths	7	.80	44.80
Sprayers	Spray roofs, bottoms, etc., on cars at night.	3	.80	19.20	Sprayer-blaster ..	When no sandblasting work, sprays cars in spray booths	1	.80	6.40
Helper	Assist night sprayers...	1	.57	4.56	Helper	Assist sprayers in spray booths	1	.57	4.56
Sprayer	Spray trucks in yard....	1	.80	6.40	Helper	Carry paint from mixing room to sprayers.....	1	.57	4.56
Sprayer-blaster ..	When no sandblasting work, sprayed roofs, etc., at night.....	1	.80	6.40	Helper	Grease and clean glass on cars handled in spray booths	1	.57	4.56
					Tractor driver....	Help move cars in and out of shop and spray booths	1	.69	5.52
	Total	22 men		$137.12		Total	13 men		$78.05

* Covers the 15 painters laid off between December 15, 1930, and March 17, 1931.

** Rate of pay 90 cents per hr. plus daily extra allowance of ½ hr. at time and a half

output averaged only 10.54 cars per day instead of the full quota of 12, and the number of sprayers varied from five to eight per day, averaging less than seven per day for the period, as against the present force of eight sprayers.

Spray Booths Reduce Labor Costs

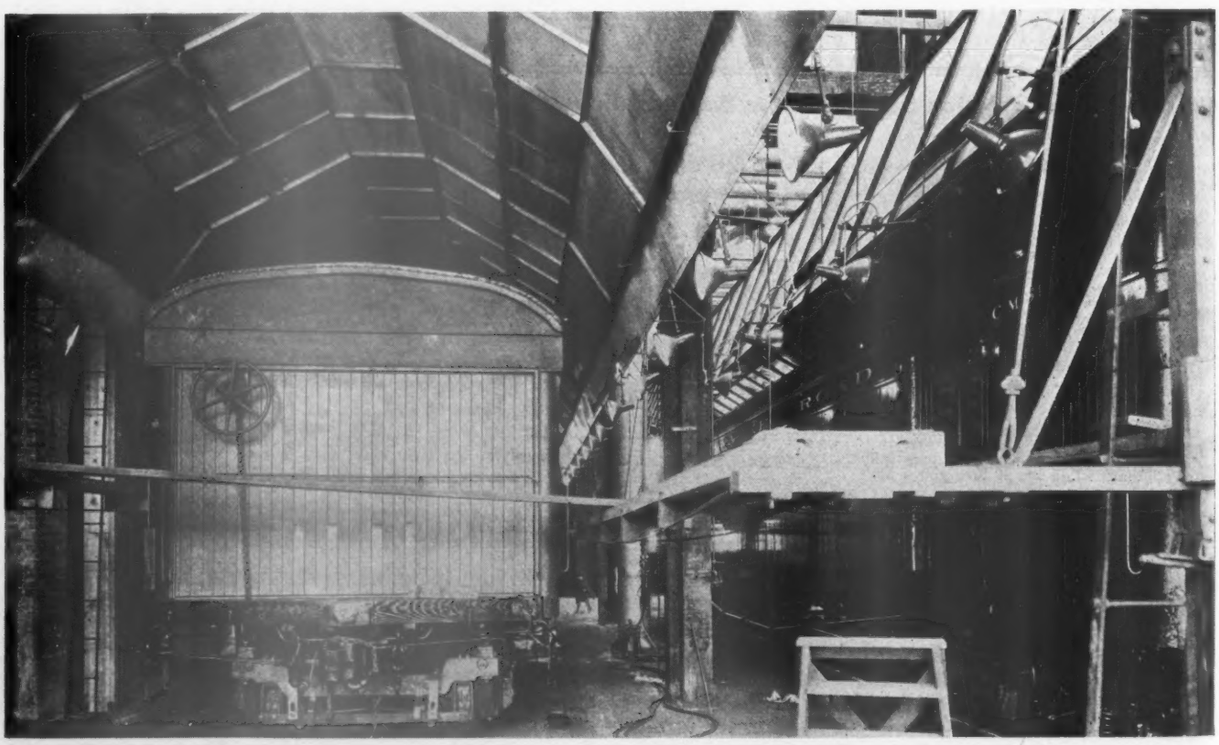
The spraying of cars under the canopies during the study period resulted in a reduction of 50.4 per cent in man-hours and 54.2 per cent in direct labor costs, compared with doing that same work by brush and spray prior to the operation of the spray booths. The details are given in Table II. The old performance time is based on the painting methods—part brush and part spray—used just prior to the operation of the booths, as of November 1, 1930, so as to give the booths no undue credit. Furthermore, the spray booths' performance time, confined to actual sprayers and one helper, is figured as being 8 man-hours per man per day, and thus includes all wasted time.

About the same percentage of saving is shown by a comparison of the former painting force with the present spraying force. Table I shows that it formerly took 15 painters, five sprayers and one helper to do the work now done by eight sprayers and one helper (the main sprayer, material carrier, glass greaser and tractor driver are excluded). This gives a 57-per cent reduction in man-hours and a 58-per cent reduction in pay-roll.

Table II—Spraying Work Done from January 13, 1931, to February 26 (26 Working Days) As Compared With Output With Former Brushing-Spraying Method

Work Turned Out During Period		Former Costs			Present Spray-Booth Costs		
Operation	No. of coats applied	Time required (man-hours)	Man-hour cost	Value of work turned out	Time required (man-hours)	Man-hour cost	Total cost of work
Color No. 1	59	520	$ .80	$ 416.00			
Color No. 2	64	507	.80	405.60			
Varnish No. 1	59	456	.80	364.80	(Spray booth costs given below cover all the 598 jobs turned out. Costs cover the actual sprayers and the one helper who dusted and cleaned off the cars. The costs, therefore, will compare accurately with the former brushing and spraying costs.)		
Varnish No. 2	63	503	.80	402.40			
Prime car body	1	16	.80	12.80			
Vestibules, two per car	40	160	.80	128.00			
Varnish woodwork	24	376	.80	300.80			
Paint ceiling, coaches, etc.	9	86	.80	68.80			
Kitchen and pantry, diners	5	40	.80	32.00			
Total of work formerly brushed	324	2,664		$2,131.20			
Bottoms	76	200	$10.96 day	274.00			
Roofs	73						
Floor, base, pipes (coaches, etc.)	38	152	.80	121.60			
Wall, ceiling, pipes (head end)	25	144	.80	115.20			
Trucks, steps, boxes, no. of cars	62	124	.80	99.20			
Total of work formerly sprayed	274	620		$ 610.00	1,421	$ .80	$1,136.80
					208	.57	118.56
Grand Total	598 jobs	3,284 man-hours		$2,741.20	1,629 man-hours		$1,255.36

The large reduction in labor costs has not resulted solely from using the spray gun instead of the brush. It is evident that the canopies have also reduced the time on jobs that were formerly sprayed before the hoods



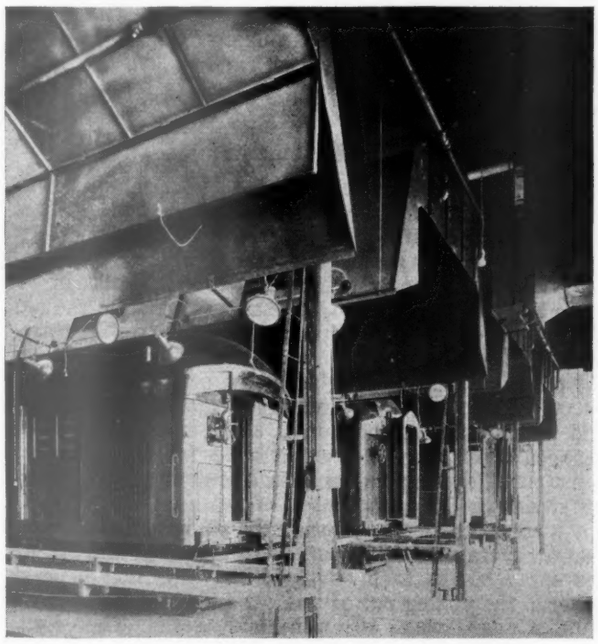
Interior of the spray hood, showing movable deflector plates, ample lighting facilities and automatic sprinkler system

were in operation. This latter reduction is undoubtedly due to the segregation of the work and the intense supervision under the hoods.

Saving in Labor Cost Per Car

The labor cost to paint a car under the former brushing-spraying method as compared with the present spraying method can be figured in three ways:

1—Based on the pay-roll (Table I), it formerly required 22 men at daily wages of $137.12 to turn out three cars a day. This is an average of $45.71 per car.



Ends of the four DeVilbiss canopy-type car exhausts installed in Milwaukee passenger-car paint shop

The present spray-booth force consists of 13 men at a daily wage of $78.05. This equals $26.02 per car. The booths, therefore, save $19.69 in labor per car turned out of the shops. This saving takes into consideration all the labor elements involved, that is, it includes the main sprayer, material carrier, glass greaser and tractor driver.

2—Confining the study to the men actually brushing and spraying (Table I), it is found that the former method required 21 men, including one helper, and cost $132.56 in wages daily, or $44.19 per car. The present spraying requires nine men, including one helper, and costs $55.76 in wages daily or $18.59 per car. The booths save $25.60 in labor per car.

3—Based on the performance time required to paint a 70-ft. car (Table IV), the former costs for passenger-carrying cars averaged $97.90 as against $68.35 for the present spray booths. This is a saving of $29.55 per car.

More Paint Material Used

During the study period, an average of 378.82 lb. of 19 different kinds of paint material, equivalent to 40.49 gal., was used daily in the spray booths. This 378.82 lb. of material was valued at $81.35. Each man sprayed an average of 55.44 lb., or 5.92 gal., of paint each eight hours.

The study shows (Table IV) that on the whole about 29 per cent more paint material is used for spraying than for brushing. However, a comparison between the present spraying and the former brushing-spraying methods shows that only about 9.8 per cent more material is now used per car. The difference between 29 per cent and 9.8 per cent is due to the fact that no more paint is consumed in spraying under the canopies than is consumed in spraying elsewhere and the increase is only on coats formerly brushed. Of the 598 jobs handled during the study period, 324 were coats formerly brushed and 274 were coats formerly sprayed.

A study of Table IV shows that, compared with brushing, the spraying resulted in 6.91 lb. more of first body color (yellow) being used per car, 2.60 lb. more of second body color (yellow) and 2.00 lb. more of exterior varnish per coat. The large increase in the amount of first body color used is undoubtedly due to the stress laid upon the necessity of building up a good paint foundation on the car. In this connection, no first colors were spotted during the study period; all were coated solid. Spotting was found to save practically no labor and produced an undesirable job.

Stress was also laid on the necessity of spraying heavy coats of paint and varnish on the cars to "drown" the dirt and to give smoother and better-appearing jobs, as well as more durable ones. In this connection, during the study period the sprayers were ordered to use the

Table III—Average Amount and Cost of Paint Materials Per 70-Ft. Car Applied by Spraying or Brushing

Paint material	No. of coats	Total length of cars, ft.	Total lb. of paint material used	Av. lb. of paint per 70-ft. car	Price of material per lb.	Av. cost of paint used on 70-ft. car	Lb. of paint per gal.	Av. gal. of paint used on 70-ft. car
Sprayed (Based on 81 individual cars handled between Jan. 13, 1931, and Feb. 26)								
First body color	58.0	3,829.5	1,000.5	18.29	$.15	$3.292	12.0	1.52
Second body color	60.0	3,932.5	827.0	14.72	.31	4.563	11.0	1.34
First letterboard red	57.0	3,785.5	218.5	4.04	.12	.485	12.0	.34
Second letterboard red	59.0	3,888.5	140.5	2.53	.43	1.088	9.5	.27
Exterior varnish	116.0	7,617.5	1,397.0	12.84	.43	5.521	7.5	1.71
Interior varnish	24.5	1,652.5	182.5	7.73	.21	1.623	7.0	1.10
Mahogany base	27.0	1,775.0	330.5	13.03	.16	2.085	8.0	1.63
Floor	28.0	1,827.0	171.0	6.55	.12	.786	10.0	.66
Vitralite ceiling	8.0	466.0	98.0	14.72	.29	4.629	12.0	1.23
Baggage-car ceiling	21.0	1,290.5	301.0	16.33	.22	3.593	11.0	1.49
Baggage-car wall	19.0	1,107.5	322.0	20.35	.22	4.477	11.0	1.85
Roof (incl. Lucas cement)	67.0	4.500.5	1,695.0	26.36	.10	2.636	13.0	2.03
Iron black	71.0	4,687.5	987.0	14.74	.13	1.916	7.0	2.11
Vestibule red, two vestibules per coat	38.0	.....	173.5	4.57	.46	2.102	9.5	.48
Truck enamel, two trucks per coat	55.5	.....	738.0	13.30	.12	1.596	9.0	1.48
Truck shellac, two trucks per coat	54.5	.....	488.0	8.95	.15	1.343	7.5	1.19
Brushed * (Based on 33 individual cars turned out of shop in October, 1930)								
First body color	33	2,079	338	11.38	.18	2.048	12.0	.95
Second body color **	33	2,079	360	12.12	.31	3.757	11.0	1.10
First signboard red	32	2,043	96	3.29	.12	.395	12.0	.28
Second signboard red **	32	2,043	61	2.10	.43	.903	9.5	.22
Exterior varnish	50	3,171	491	10.84	.43	4.661	7.5	1.45

* Figures for brush work confined to above five materials to be certain that a fair comparison with spray work is made.
** Second body color and second letterboard red include the red and yellow vitralite used on the ends of head-end cars.

criss-cross method of spraying instead of the straight up and down method. Obviously, these practices have resulted in more paint material being used than would otherwise be the case. Therefore, the increased amount of paint used in spraying, compared with brushing, cannot be charged solely to waste. From observing the spray work being done and the amount of paint on the spray-booth floors and hoods, it seems that the material actually lost is a very small percentage of that used.

The increased cost of material used on a 70-ft. passenger-carrying car turned out of shop under the present spraying method is $5.38 (Table IV). The average cost of the material used under the present spray-booth method is $38.83 per car, compared with $33.45 under the former brushing spraying method.

Based on an output of three cars a day, the output being at the ratio of two head-end cars to three passenger-carrying cars, and at the average car length of 60 ft. for head-end cars and 63 ft. for passenger-carrying cars, the average increased cost is $12.88 a day for the paint used by the spray booths compared with the former methods. This gives an average increased material cost of $4.29 per car turned out.

Referring to Table IV, the labor costs are based on painters and sprayers only and do not include the auxiliary forces except for one sprayers' helper for each method. The figures show that about $29.55 in direct labor and material is saved for each 70-ft. passenger-carrying car turned out of shop. The savings will, of course, vary according to the kind and length of the car, and the amount of work on them that is now sprayed and which was formerly brushed.

The figures also show that under the former method the labor cost was greater than the material cost, whereas under the present spraying method the material cost is greater than the labor cost, a complete reversal.

Labor and Material Charge-Out Method

The operation of the spray booths necessitated a change in the method of charging labor and material to individual cars. Formerly, each painter charged to each car he worked on the actual number of hours he worked on it. In the spray booths, this method was found impractical due to the numerous jobs each sprayer worked on and the shortness of the working time per job. Therefore, each sprayer spreads his daily eight hours over the number of cars he worked on that day. Each individual car gets an approximately correct charge.

In the matter of charging out material under the former method, the mixing room weighed and charged the material to each individual car and weighed and credited each individual car with the unused material returned. This method was found impractical for the spray booths for it is evident that paint could not be removed from spraying containers and hose and weighed every time a different car was worked on. Therefore, the mixing room each day weighs and charges against the spray booths all outgoing material and weighs and credits the spray booths with all material returned. The spray booths each day furnish the mixing room with a list showing the work done on each car handled, and from this the mixing room charges the used material against the individual cars.

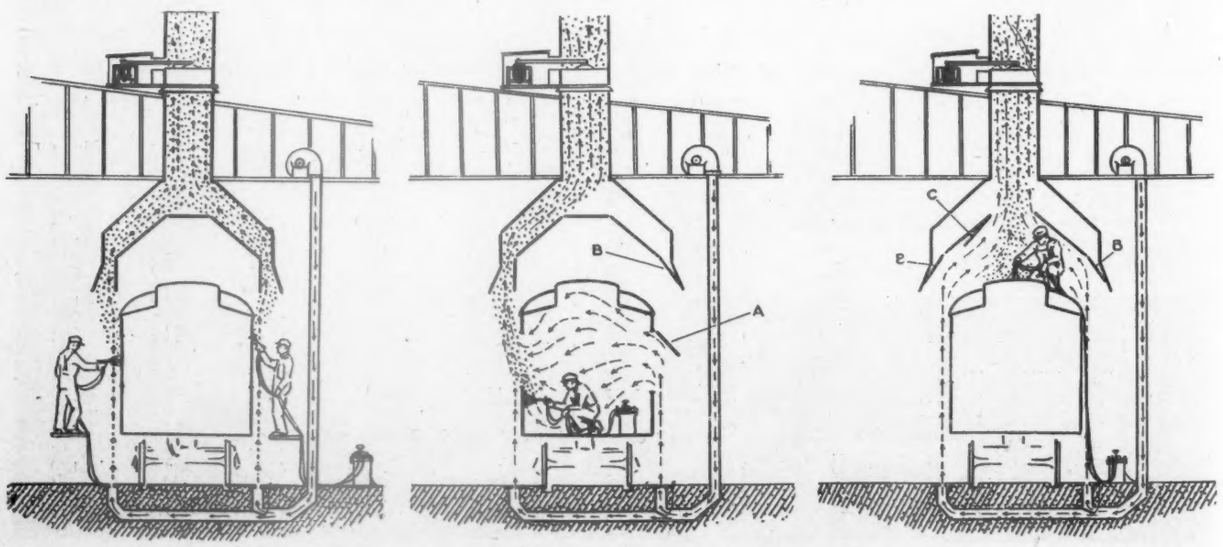
Car Movements

The movement of cars in and out of the spray booths, and between and in and out of the coach shops has become an important operation since the spray booths started. During a normal day, 16 cars are moved in and out of the spray booths, three cars enter and three cars leave the coach shops, and three cars move from the old shop to the new shop and three cars move from the new shop to the spray booths. This gives 25 car moves on the old shop transfer table each day, or a car movement every 19 min. Only by using a tractor for pushing and pulling cars in and out of shop, and pulling them between shops, has it been possible for the old shop transfer table to handle the other movements. The tractor speeds up the operation.

An actual check made during the study period showed that an average of 15.73 cars were moved in and out of the spray booths each day, and the time that elapsed between the pulling out of one car and the putting in of another car was 16 min., 24 sec. Therefore, each day an average of 2 hours, 9 minutes was lost in the spray booths, due to empty stalls between the out and in car movements. In other words, of the 32 car-hours (4 stalls x 8 hours) in the spray booths, 6.25 per cent was lost or unproductive due to car movements.

Speeds Up the Shop Work

The spray booths have resulted in a speeding up of the



Operation of canopy-type car exhaust for exterior, interior and roof painting

Table IV—Average Cost of Spraying a 70-Ft. Passenger Carrying Car (All Classes), Compared with Former Brushing Spraying Method

	Material Costs						Labor Costs					
	Lb. of material used			Cost of material used			Number of man-hours spent			Cost of direct labor used		
	Former brush and spray	Present spray booths	Approximate increase	Former brush and spray	Present spray booths	Approximate increase	Former brush and spray	Present spray booths	Approximate decrease	Former brush and spray	Present spray booths	Approximate decrease
					Formerly brushed							
First letterboard red *	3.29	4.04	.75	$ .395	$ .485	$ .090	....			.....		
Second letterboard red *	2.10	2.53	.43	.903	1.088	.185	....			.....		
First body color	11.38	18.29	6.91	2.048	3.292	1.244	10			$ 8.00		
Second body color	12.12	14.72	2.60	3.757	4.563	.806	10			8.00		
Exterior varnish (2 coats)	21.68	25.68	4.00	9.322	11.042	1.720	20	See Note A		16.00	See Note B	
Interior varnish **	6.52	7.73	1.21	1.369	1.623	.254	16			12.80		
Vestibules **	3.63	4.57	.94	1.670	2.102	.432	4			3.20		
Vitrolite ceiling **	12.50	14.72	2.22	3.625	4.269	.644	10			8.00		
Total formerly brushed	73.22	92.28	19.06	$23.089	$28.464	$ 5.375	70			$56.00		
					Formerly sprayed							
Mahogany base	13.03	13.03		$ 2.085	$ 2.085		4			$ 3.20		
Floor	6.55	6.55		.786	.786		....			.....		
Truck enamel	13.30	13.30	See Note C	1.596	1.596	See Note C	2	See Note A		1.60	See Note B	
Truck shellac	8.95	8.95		1.343	1.343		....			.....		
Roof (Note D)	26.36	26.36		2.636	2.636		5.3			3.65		
Iron black	14.74	14.74		1.916	1.916		....			.....		
Total formerly sprayed	82.93	82.93		$10.362			11.3			$ 8.45		
Grand total—70-ft. car	156.15	175.21	19.06	$33.451	$38.826	$ 5.375	81.3	40.3	41.0	$64.45	$29.52	$34.93

Note A—Present man-hour saving is 50.4 per cent per Table II—Hence thus figured.
Note B—Present labor cost saving is 54.2 per cent per Table II—Hence thus figured.
Note C—No more material consumed in present spraying than in former spraying.
Note D—Includes Lucas cement.
*—Labor cost included with body colors.
**—Material formerly used with brush is estimated

AVERAGE SAVING PER CAR

	Former brush and spray	Present spray booths
Labor	$64.45	$29.52
Material	33.45	38.83
Total	$97.90	$68.35
Saving	.....	$29.55

entire shops. The booths can be compared to a hungry beast which must be fed each day with three cars for first coat color. It is necessary for the coach repair shops and all its auxiliary departments to furnish the three cars. The result has been a faster performance in the repair and manufacturing shops.

Formerly, when a car for any reason could not be shifted, it resulted in only a trifling delay because the painters could move to the car and paint it where it stood. No time was lost. Under the present method, unless a car is shifted, no paint is applied and each outside coat of paint represents one day in the shop. This problem has been met by selecting another car to shift in place of one that cannot meet its shifting date. It is evident from the above that work must be completed on time or serious delays result. The result has been a speeding up in the coach repair shops so as to have cars ready for movement into the spray booths. Obviously, when one car is selected to shift in place of another car, it means the changing of the shop schedule dates as well as the out-of-shop date for the cars involved.

To avoid wasted time, the trimmers are not allowed to start trimming a car until it has left the spray booths completely painted. This ruling was necessary to prevent delays in the spray booths which would result if cars could not be promptly moved when wanted. Also, it avoids a continuous switching around of trimmers, etc., which would result if they were allowed to work on cars scheduled to enter the booths on a moment's notice.

Workmanship

The workmanship of the painting jobs done by spray has steadily improved with the increased experience of the sprayers. The jobs seemingly should be more durable than those formerly brushed inasmuch as heavier coats are applied to the surfaces.

It has been found that the greatest foe to good workmanship is dirt. The booths have combatted dirt by drowning it in heavy coats of paint and varnish. Also, the spray booths are kept as clean as possible, the floor is wetted down, incoming cars are swept out before entering the booths, and traffic through the booths has been stopped. Again, by properly regulating the air drafts from the fans and blowers, the dust floating in the air has been lessened.

Undoubtedly, quick-drying varnish made from synthetic gums will be a great aid in preventing dirt from collecting on the cars, especially after the cars leave the spray booths.

Miscellaneous

Nineteen, or more, different kinds of paint materials are used on Milwaukee cars. The use of various kinds of paint results not only in much "cutting in," but also in much cleaning of spraying equipment when sprayers change from one material to another. It also, without doubt, slightly increases the amount of material used.

It is estimated that the spraying force could be reduced one sprayer—a labor reduction of 12.5 per cent—if one solid outside body color were used on Milwaukee cars instead of the various colors now used.

The paint materials used by the sprayers were identical with the materials that were formerly applied by brush. The operation of the spray boths resulted in no change in the kinds of paint materials used. Lacquer is not used on Milwaukee cars, and they are sprayed with paints and varnish.

"Safety-first shoes."—Shoes with a steel toe cap inside the leather cap are now worn by many shop employees of the New York, New Haven & Hartford and the company is so well satisfied with the design of the shoe, as a safeguard against foot accidents, that it has arranged to have salesmen travel throughout the company's lines to offer the shoes to employees; and payment may be made by deduction from the payroll. The shoes cost $3.95 a pair. In three months, on this road, 119 foot injuries were sustained by employees, 32 of which were of sufficient importance to be reported to the Interstate Commerce Commission. These injuries altogether led to 1,074 days' lost time. The shoes are recommended to shopmen, car inspectors, trackmen, and all classes where the hazard is appreciable.

Is the Big Car Shop Justified?

By B. C. Richmond

UNDER normal business conditions, the actual cost of maintaining freight cars per car is of relatively less importance than it is under traffic conditions such as are being experienced on the railroads at the present time. The demand then for freight equipment is so great that the importance of having serviceable cars outweighs any consideration of a small difference in the cost per car for repairs. However, when railway traffic falls off during business depressions, all costs on the operating expense side of the ledger are scrutinized carefully to determine where savings may be made.

This article is being written because of an idea on the part of the writer, based on several years' experience in car repair work, that in most cases it is cheaper to repair freight cars in several relatively small capacity repair shops, strategically located in relation to traffic, than it is to centralize freight-car repair work in one large shop designed to turn out from 40 to 60 cars a day. Comparative analyses of freight car repair costs under several conditions substantiated the contention that the smaller shop is more economical and raises the question, "Is the big shop justified?"

The author raises some pointed questions relative to the trend of car-repair work. Does the geographical make-up of most roads lend itself to the one-shop idea? Has the trend toward the concentration of car-repair work reached its peak? Do the fixed charges on large repair plants offset the savings made by mass-production methods?

Practically every well-operated railroad has freight-car repair shops of some description at several points on the road at the present time. During the past five years the trend in shop practice has been, on many roads, to abandon these smaller shops and concentrate freight car repairs at one large-capacity modern repair shop. The big shop—one turning out from 40 to 60 general-repair or rebuilt cars a day—is a most uneconomical investment at any time when it is not operated at from 85 to 100 per cent of its capacity on repairs of this class alone. There is no justification whatever for a shop of this size being built or used for making light repairs at any time. The minute this is done the cost of making such lighter repairs increases all out of proportion to the value of the repair work performed. The thought is that most roads could much better afford to spend a rather liberal amount of money in modernizing the several relatively small repair plants now in existence on their lines, provided that these repair plants are located at strategic points in relation to traffic.

Classification of Car Repairs

Since the time of the United States Railroad Administration, when a definite classification of locomotive repairs was set up on all the railroads under Federal control, there has been no confusion in the minds of railroad men concerning the classification of locomotive repairs. They are fixed and definite. No such condition exists as far as car repairs are concerned, and while it is more or less common practice on most roads to set up certain classifications of car repairs, it can be shown that in relation to shop operations such classifications mean very little. The only classification that exists at the present time on car repairs which is common to all roads is that set up by the Interstate Commerce Commission which specifies that all cars requiring between one and 20 man-hours per car for repairs shall be known as light repairs and all cars requiring 20 and over man-hours be known as heavy repairs. When it is considered that the heavier repairs on cars will average from 35 to 100 man-hours of direct car labor—not including such items as painters, air brake men, etc.—it can be seen that such a classification serves no useful purpose in analyzing car repair programs or costs.

Many roads use a classification of freight car repairs such as the following:

Class 1—Cars requiring one man-hour or less
Class 2—Cars requiring one to 20 man-hours, inclusive
Class 3—Cars requiring 21 to 100 man-hours, inclusive
Class 4—Cars requiring 101 man-hours and over

The inadequacy of such a car-repair classification is evident when it is considered that the classification depends upon the man-hours to make the repairs on a car and the man-hours required to make the repair depends entirely upon the shop and facilities at which the repairs are made. It can be seen, for example, that on a road with a main shop which requires an average of 85 man-hours to make general repairs to a 55-ton hopper car, it is possible that an emergency might require general repairs to be made on such a car at some small outlying point which, because of lack of modern facilities, could not repair the car in less than, say, 150 hours. The same car receiving the same repairs would, at the main shop, fall under Class 3, while for the repairs at the outlying shop it would fall into Class 4. Therefore, when a comparison of car repair costs is made on the basis of any such classification, it can readily be seen why it is not a true and accurate comparison.

Determining Shop Output

In determining shop output on a basis of classification consideration must be given to this variation in the ability of different shops to repair cars. Some roads schedule car repairs by series or groups for general or intermediate repairs and anticipate that a certain number of other cars will be repaired. These "other" cars are those unusual repair jobs which are occasioned by wrecks, etc. Usually the large heavy-repair shops are

designed with the idea of including in their repair operations many such non-program cars. Many times, under certain conditions of traffic, it is necessary to shop a large number of cars, the repairs on which are of a lighter nature than "general" or "rebuilt" in order to justify the existence of the big shop for the reason that not enough general-repair cars are available to keep the shop operating at an economical capacity. In other words, the heavy fixed charges involved in connection with the big shop must be spread over a large number of cars in order to keep the average cost per car as low as possible.

A railroad owning 50,000 steel cars would be obliged to repair on a "general" or "rebuilt" basis only about 14 cars for each working day in order properly to maintain the equipment on the basis of 12 years service life. The 50,000 cars would probably require intermediate repairs and painting at a six-year interval which would increase the required daily output by 27 cars, making a total of 41 cars a day receiving repairs, only 14 of which are of a nature which would justify putting them through the big shop. A big shop is designed primarily for making the heaviest repairs. Under certain conditions a road may be justified in including a limited number of intermediate repairs—say 25 to 30 per cent of the output. If light repair cars are moved into the big shop simply to provide output for the big shop, it will usually be found that small terminal or division shops are short of work for their repair men. A certain force is necessary at these outlying points to perform running repairs and, because of the fact that ordinary running repairs require only a portion of the time of this force, practically every road figures that the remaining time of these repair men be occupied with a certain number of heavier repairs each month. Therefore, when the big shop takes all of the heavy repairs, it leaves the repair forces at outlying points, which must be maintained in any event, with only half enough work to do. It so happens in many cases that supervisors will deliberately "bad order" cars which are still in serviceable condition in order to create work for repair forces that might otherwise be idle.

"The minute the big shop is used for making light repairs, their cost increases out of all proportion to the value of the work performed."

"When the big shop takes all the heavy repairs, it leaves the repair forces at outlying points, which must be maintained in any event, with only half enough work to do."

Shop Location Important

There are only about four or five railroads in the United States of any size, the geographical and traffic nature of which is such that the freight equipment might economically be repaired in one centrally-located shop. As far as most roads are concerned the location of the car-repair shop or shops in relation to the types and nature of its traffic is vitally important. Where, then, should the big shop be located?

Shop locations should be based on the assumption:

(a) That the equipment is being repaired in the territory where the lading for which that particular type of equipment is used, originates or in the territory from which the cars are distributed.

(b) That, if cars are not repaired in loading or distributing territory, the transportation costs on the empty car from loading territory to the shop and return does not exceed the savings which it is expected can be made in the central shop in mechanical repair costs.

There is a distinct advantage in being able to repair cars in loading territory. A road with diversified freight business such as coal, grain, live stock, automobiles and parts or accessories would, in all probability, be unable to find a central location for a car shop. As an example, consider a hypothetical trunk line extending from coast to coast divided into two operating sections—lines east of Chicago and lines west of Chicago. The lines east extend into the Western Pennsylvania, southern Ohio, Indiana and southern Illinois coal fields and into the Ohio, Indiana and Michigan automobile industrial centers. The coal movement would be in a northerly direction from the mines to the main line on four different feeder lines meeting the main line at points approximately 100 miles apart and within a 400-mile territory. The automobile traffic loads from three points practically on the main line and two off-line points. With two exceptions all of these points are within territorial limits 120 miles from a central location, the two exceptions being within 250 miles. The grain and live stock movement is from the western terminus east on the main line. The movement from the eastern terminus west on the main line consists principally of empties and of merchandise and manufactured products. The loaded coal movement in several instances ends at Great Lakes ports, the cars returning empty to the mines. Part of the coal, after reaching the main line, is moved in both easternly and westernly directions and the empties returned to the mines. However, due to the geographical distribution of bituminous coal resources, long hauls are usually unnecessary and the greater part of the feeder-line coal-carrying cars are operated in a territory restricted practically to that feeder line and 50 to 100 miles of adjacent main line. Therefore, any central shop for coal-car repairs would entail a considerable amount of empty-car mileage. In the case of cars used in automobile traffic a moderate sized centrally-located shop would fulfill the requirements for repaired cars.

On the Western lines the principal eastbound movement would be fruit, livestock and grain. The fruit originates in the far west, the live stock in the southwest and the grain in the central western states. From southern lines extending to the Gulf the north and eastbound movement would consist of fruit, grain, lumber and oil. The west and southbound movement would be empty cars and merchandise and manufactured articles. The logical locations for car repair plants on the lines west of Chicago would be as follows: For refrigerator cars, one shop on the west coast; livestock cars and grain cars are distributed for loading from the central west and repairs should be made in that territory. On the southwest lines the refrigerator cars should be repaired in a shop in the Gulf States; cars for grain and lumber are distributed from central western termini and because of the converging traffic of the western and southwestern lines in this central western distributing territory the repairs on stock, box and open-top equipment could be handled in two or three moderate sized shops each spe-

cializing on the repairs to specific classes of cars. Inasmuch as most of the tank cars are owned by the oil producers their maintenance is not a serious problem of the railroad.

There is a charge of five cents a mile for empty car movement which is used by practically all roads. With centrally located shops there would be considerable empty car mileage from the traffic originating and distributing points to the shop and return. This would involve a substantial charge per car which must be considered along with the actual cost of making repairs.

Shop Costs Compared

In making any comparison of repair facilities it must be done on some definite basis. The basis selected for use in this article is a comparison between freight-car repair programs on a road owning 50,000 freight cars, 37 per cent of which are box cars, 40 per cent open-top equipment, 16 per cent other revenue cars and 7 per cent non-revenue cars. The present set-up on this road is assumed to be four repair plants of moderate size already in existence and located at different points on the road. These repair plants, because of a lack of modern facilities, are considered to be inadequate to meet present day car-repair needs and it is now a question of installing modern shop facilities. The question that has arisen is whether one large centrally located shop should be built or a certain amount of money spent for the modernization of existing facilities.

An analysis of the car-repair requirements on this road indicates the desirability of having shop facilities capable of turning out 14 general-repair or rebuilt cars and 27 intermediate repairs each working day, or 12,300 cars a year. In addition to this there would be a certain number of miscellaneous cars requiring varying degrees of repairs due to accidents, etc. Making a certain reserve allowance of shop capacity for future needs, an analysis indicates the desirability of having a total shop output capacity of approximately 60 cars a day. To meet this requirement, two solutions are possible—one shop capable of meeting the entire requirements or the modernization of the four small shops to produce an average output of 15 cars a day each. Preliminary estimates of costs based on the actual experience of some roads in constructing large shops place the cost of a single repair plant capable of turning out 60 cars a day at $3,000,000 to $3,500,000. Similar estimates as to the cost of modernizing four existing repair shops in such a manner as to increase their output to 15 cars a day would cost about $80,000 apiece or $320,000 for the four shops. The present book value of the existing facilities is assumed to be in the neighborhood of $800,000 for the four shops, making a total investment of $1,120,000 for the four shops should they be modernized.

An investigation of the fixed charges in connection with the big shop—the $3,500,000 shop—as compared with the four smaller shops involving slightly over $1,000,000 discloses the fact that the annual cost of interest at 6 per cent, depreciation at 4 per cent, taxes, fuel, water, light, electric power, insurance and maintenance of buildings and equipment distributed over 12,300 cars is $38.70 per car for the big shop as compared with $13.90 for the four small modernized shops. Using an average cost of $300 for the general and intermediate repairs on these 12,300 cars, the fixed shop charges represent in the case of the big shop 12.9 per cent of the repair cost as compared with 4.6 per cent in the case of the small shop. Is the big shop justified?

Ten years ago there was every indication, based upon years of railroad history, that railroad traffic would increase in a proportion which bore a definite relation to increases in population. Upon such an assumption the railroads were justified in recommending expansion of facilities to care for constantly increasing repair requirements. The situation is now changed. There is every indication that the peak in traffic increases has been reached and this, together with increased transportation-department efficiency, indicates that the need for great increases in car-shop capacity no longer exists. This opinion is corroborated to a certain extent by the fact that the modern trend is toward the steel car which need be shopped for general repairs only every 12 to 15 years as compared with average shopping periods of approximately six years on the old wooden equipment. Under present conditions the policy of the railroads as related to repair facilities should be to consider very carefully proposed expenditures made solely for the purpose of increasing capacity. On the other hand, present conditions are forcing attention, more than ever before, upon the necessity of reducing operating expenses and the installation of modern equipment is one of the many ways in which money can be spent which will not only hold within moderate limits the fixed charges but will make a substantial return on the investment.

Why the Old Shop Fails

Many car-department supervisors reach the conclusion that facilities which have been in use for a number of years are totally inadequate to meet present day needs and that the only solution to the problem is the complete abandonment of these facilities and the erection of new and modern layouts. To a certain extent, this is true, particularly in cases were the shop layout is so broken up by buildings occupied by other departments that it is impossible to concentrate the car work in one place in an economical manner and in cases where the buildings themselves are in such physical condition as to require extensive repairs to fit them for use. In such cases probably the most economical thing to do is to dismantle the buildings completely and replace them with new buildings. On the other hand, many present car-repair plants are housed in buildings that are not undesirable from the standpoint of layout and which have, with slight repairs, many years of remaining service life. These are the shops in which moderate expenditures for modernization will provide a satisfactory return on the investment in better facilities.

The labor force in any car-repair shop is capable of turning out a certain number of cars a day—this output being definitely limited in direct relation to the number and type of facilities in the shop. The problem of increasing the output of car-repair work and reducing the cost of maintenance per car is not one of replacing men with machines but is rather a problem of supplementing labor with sufficient facilities and tools to obtain the maximum output from a given force.

Problems Requiring Solution

Before entering upon any discussion of the details of shop layout and equipment, there is one point worth mentioning. A debatable question among car men in the matter of shop layout has always been that of the relative efficiency of the dead-end shop as compared with the through-track open-end shop. Many car-repair shops at outlying points have been abandoned simply because they were dead-end shops with the feeling that it is not possible to equip and operate a dead-end shop so as to equal the efficiency of a shop where the cars can move into, through and out of the shop in a straight line. It is not within the province of this article to

become involved in any detailed analysis of the two types of shops but experience has proved conclusively to the writer that the dead-end shop, particularly in the small units such as we are discussing here, can be operated just as economically if not more so than the through type of shop.

In setting up the recommendations for the modernization of existing plants, it is assumed in this article that no steel car materials are fabricated in the shop. The present tendency on most progressive roads is to purchase fabricated car parts from the manufacturers and thereby eliminate the investment in shop equipment required to perform this work.

Machine Tools and Shop Equipment Necessary to Repair 60 General or Rebuilt Cars a Month

Machine	Old Shop	New Shop			
		Open-top cars		House cars	
		A	B	C	D
Shop piped for oxy-acetylene	No	Yes	Yes	Yes	Yes
Sand blast equipment	Q	Yes	Yes	Yes	Yes
Spray painting equipment	Q	Yes	Yes	Yes	Yes
15-ton traveling crane	No	Yes	Yes	Yes	Yes
Jib cranes, 5-ton electric hoists	No	2	2	2	2
Storage-battery crane truck	No	1	1	1	1
Gasoline tractor	Yes	2	2	1	1
Caterpillar tractor	No	1	1	1	1
Oil- or gas-fired straightening furnaces 10-ft. by 10-ft. inside	Yes	2	2	2	2
Electric hoists, 1½ tons capacity	No	2	2	2	2
Electric hoists, 3 tons capacity	No	1	1	1	1
Blacksmith forges	Yes	2	2	2	2
Motor-driven blast fan	No	1	1	1	1
Air compressor, motor-driven, 500 c.f.m.	One	2	2	2	2
Portable arc welder	No	1	1	1	1
Pneumatic car-lifting jacks, 50 tons	No	10	10	10	10
Ratchet car jacks, 35 tons	Yes	12	12	12	12
Straightening jacks, push and pull	O	10	10	4	4
Pneumatic backing-out hammers	No	10	10	6	6
Power trimming saws, electric	No	0	0	2	2
Rivet heaters, gas or oil	Q	45	45	30	30
Pneumatic riveting hammers	Q	30	30	18	18
Electric winch for pulling cars	No	1	1	1	1
Electrically driven pneumatic hammer, 1,500-lb.	No	1	1	1	1
Power hammer	No	1	1	1	1
Forging machine	No	1	1	1	1
Double-end grinder	One	2	2	2	2
Grindstone	One	1	1	1	1
Double-end hydraulic wheel press	One	1	1	1	1
48-in. car-wheel boring mill	One	1	1	1	1
Steel-wheel turning lathe	One	1	0	1	0
Axle lathe	One	1	1	1	1
Car-wheel journal lathe	One	1	1	1	1
Pipe-threading machine	One	1	1	1	1
Pneumatic pipe vise	No	1	1	1	1
Pneumatic pipe bender	No	1	1	1	1
24-in. wood planer	Yes	0	0	1	1
Universal wood worker	No	1	1	1	1
24-in. rip saw	Yes	0	0	1	1
16-in rip saw	Yes	1	1	1	1
Band saw	Yes	1	1	1	1
36-in. cut-off saw	Yes	0	0	1	1
16-in. cut-off saw	Yes	1	1	1	1

Another important problem that must be solved in any discussion of car-repair shops is a question of handling wheel and axle work. While some roads have a great part, if not all, of the wheel and axle work handled outside their own shops, it is assumed in this article that the railroad is handling its own wheel and axle work. The question then resolves itself into one of deciding whether the wheel and axle work shall be handled in one centrally located wheel shop or at two or four points on the road. It might be well to mention here that the comparison in this article is being drawn between a central car repair shop turning out 60 cars a day and four shops of moderate size shops located at four points on the system each turning out 15 cars a day. An analysis of the wheel problem will indicate the facilities required for handling wheel work.

A road having 50,000 freight cars, 2,000 to 2,500 of which are equipped with steel wheels, will find it necessary to provide facilities to turning about 700 pairs of steel wheels a month. This figure of 700 pairs a month includes not only the cars owned by the railroad but the wheels turned for foreign cars. To perform this work will require the full time operation of two modern wheel lathes. In addition, to care for the machine work required on cast-iron wheels, axles and the mounting and demounting of wheels, will require the following machine tools assigned exclusively to wheel and axle work:

4—car-wheel boring mills
4—axle lathes
4—wheel presses
4—car wheel journal lathes

Regardless of whether the wheel work is handled in one shop or at four different shops the output of mounted wheels for a road with 50,000 cars remains the same—about 40 to 45 pairs a day. As far as the machine-tool equipment is concerned, the only difference between performing the work in four shops and doing it at one central shop would be the difference in the number of wheel presses required. If the work is performed at four different points each having one wheel press, it will be necessary to use the press 50 per cent of the time on demounting wheels and the remaining time on mounting wheels. If the work is performed at one central shop, two wheel presses, one for mounting and one for demounting, will take care of all of the requirements. The saving in favor of the one central shop, therefore, insofar as investment in shop equipment is concerned, is the cost, interest, depreciation and maintenance on two wheel presses. Against this saving, however, must be charged the cost of transporting wheels from outlying points on the road to the wheel shop and returning them again to the point where they will be needed. On several roads this cost is figured on a freight charge of .007 cents per ton mile.

Handling Parts and Materials

All shop operations are divided into three phases—fabrication, delivery and assembly of material. In the shops being discussed in this article we have already stated that there will be no fabrication. Therefore, the shop operations with which we are concerned are those of the delivery and the assembly of material. Adequate material-handling equipment is of great importance in both of these phases of operation. It has been stated previously in this article that a given labor force is limited in its ability to turn out repaired cars only by the facilities which are provided for the force to work with—assuming, of course, that the problems of organization and personnel have been solved. It is impossible to deliver or assemble the amount of material required in normal car-repair operations by manual labor alone without involving an excessive number of men. A labor force of 200 men, including supervision, should be entirely adequate to turn out 15 general or rebuilt and intermediate repairs a day. Time studies on several small shops actually in operation indicate that such a force, without modern facilities, cannot turn out 15 cars a day. One such shop, with a total force of 208 men, was actually getting 12 cars a day with a labor force involving 120 men employed on direct car-repair work and 88 men on indirect labor. This same shop, when equipped with modern material-handling equipment and tools, involving an investment of less than $75,000, increased its daily output from 12 to 17 cars with no change in the total number of men employed. The distribution of the men employed however, changed, for under the new layout less men were required on indirect labor operations and more could be utilized on direct car-repair operations. The distibution under the new set-up was 148 car repairers and 60 men whose time was charged as indirect labor.

It is unnecessary to go into detail as to just why cer-

tain items are recommended or what they are used for. The recommended improvements in four shops of the size considered above are shown in Table I. An explanation of the table will clarify its purpose. The items listed in the table represent a complete list of the major equipment required in a shop for steel and composite freight-car repairs. There are, of course, other small miscellaneous pieces of equipment that have been omitted from the list simply because they are in common use in all shops. In the column headed "Old Shop" are several notations indicating whether or not the old facilities included the item mentioned. In connection with those items marked "Q" this is meant to indicate that it is questionable whether or not the old shops are equipped with those items or, if equipped, whether or not they are adequately equipped. There are four columns headed "New Shop." In the first two columns, A and B, are listed the amount of equipment in two of the four shops assigned to repair work on all-steel open-top cars, while in the remaining two columns, C and D, is similar information for the other two shops assigned to the repair of steel and composite house cars. Any one of the four columns in the table will provide a list of the equipment necessary to equip completely a shop having an output of 15 cars a day of the type mentioned while the total of the four columns will provide a list of the equipment necessary for an output of 60 cars a day. The difference between the quantities indicated per shop in the column headed "Old Shop" and the quantities under columns A, B, C and D, will provide a list of the tools and equipment required for modernizing the average shop now in existence.

Great Northern Modernizes Engine Terminals

(Continued from page 291)

At Grand Forks, N. D., also at Havre and Whitefish, Mont., electric-stack draft-fan units, of the Drafto type, have been installed in sections of the enginehouse with a view to more economical firing-up of locomotives and also to save the large amount of heat lost through the smoke jacks in cold weather. At smaller terminals, where existing boiler capacity has been insufficient to support the direct steaming system and not enough locomotives are handled to justify enlarging or renewing the power plant, the Great Northern has followed the practice of installing Drafto units to save steam for blowing and heating purposes and also to keep smoke and gases out of the enginehouse.

Boiler-Washing Facilities

Another development that has contributed materially to the improved efficiency of locomotive terminals on the Great Northern has been the extension of facilities for washing out and refilling locomotive boilers with hot water. This is particularly important in a territory such as that traversed by this road where frequent boiler washouts are required. It is also essential to have facilities of this type preliminary to the operation of direct steaming systems such as now in general use on that road. Within the last ten years no less than fourteen of the present locomotive terminals on the Great Northern have been equipped with hot-water washout and boiler filling plants so that every important terminal on this road is now equipped for washing and refilling locomotive boilers with hot water. A number of these plants have since been rehabilitated, steel and concrete hot-water tanks of larger capacity being substituted for the original wood tanks, more efficient separators and condensers have been installed with gratifying results.

No exact estimate in the form of figures or ratios can be offered to indicate the full value of these terminal improvements to the Great Northern. Statistics comparing the cost of handling locomotives turned at these terminals ten years ago with today would be clouded by developments in the character of motive power handled and other changes in operating conditions that have occurred during this interval. Almost all of the individual improvements are susceptible of such analysis as outlined. Probably the best appraisal of the combined effect of all improvements embraced in the entire terminal program would be to regard them as just one of the several important factors that are enabling the Great Northern to score the lowest operating ratio of any transcontinental road operating in its section of the country.

* * *

Handling wheels in the car shop

EDITORIALS

The Parting Of The Ways

The railroads, in their relation to machine tools and shop equipment, have arrived at much the same point as they have in relation to modern motive power. For years motive-power engineers, locomotive builders and others have been trying to sell the railroads to the idea that the investment in modern, efficient locomotives would result in substantial economies and, more than that, the continuance of obsolete types in service or even the attempt to modernize many obsolete types was not an economy but that it caused an actual operating loss.

Strange to say, it took a business depression to drive home a point that years of educational work had failed to impress upon some railroad officers. With the falling off of traffic and the consequent reduction of train miles it became necessary to store power but, unlike the farmer's Sunday suit, the newest power was not "put up in moth balls" until the old power was all worn out. Why not? Simply because it is obvious to almost any railroad man, whether he occupied the S. M. P's. job or is on the night shift at the engine house, that in times like these it is necessary to save money on operation and the old power cost too much to run—too much in fuel, too much in repairs—not to mention the fact that it was unsuited to modern operating conditions.

The average mechanical officer would demand an early explanation from any master mechanic today who would white-lead the new power and run the old. But that same officer will look askance at the shop superintendent or general foreman who has the temerity, in times like these, to ask for a new machine tool or unit of shop equipment. If the railroads, like other industries, had a predominance of modern facilities in their shops such a policy might be justified but almost any shop over ten years old contains many tools that should grace the scrap heap if for no other reason than to stop their excessive losses in operation and to stop the waste of material and the defects in service resulting from inaccurate work. The locomotive builder has shown the railroads the way to lower operating costs as far as motive power is concerned, yet in many cases the savings made on the road are wiped out by excessive maintenance costs in the back shop—costs that could be cut down if the same policy were applied to the shop as is applied to the motive-power problem.

This problem of reducing maintenance costs is one that is considerably deeper than the mere acquisition of new machine tools and shop equipment. It is a problem involving a study of the broad question of the economics of equipment maintenance. It is a problem that must be solved by the co-ordination of the proper facilities with an adequate well-trained labor force guided and controlled by policies that are flexible enough to detect improper and inefficient practices before they have run up heavy losses and to adopt without hesitation the developments which modern science and engineering have made available.

In the campaign on the reduction of operating expenses that must form a most essential part of railroad programs in the future the possibility of reducing locomotive repair costs presents a favorable opportunity if for no other reason than it is still the largest single item of railroad operating expense—over $400,000,000 annually for the Class I roads. In the years from 1923 to 1929 inclusive locomotive fuel costs have been reduced 37 per cent while 8,000 fewer locomotives have run within 4 per cent as many locomotive-miles. During the same period maintenance costs have gone down 25 per cent. It would appear that the designers and operators of the locomotive have made greater progress than those who maintain it.

Modern railroad repair plants, whether they be large units or small, have demonstrated their ability to cut unit costs. No one can deny that progress has been made but that $400,000,000 annual expenditure stands out at the top of the list as a challenge to all mechanical officers to turn their attention to a new avenue of savings. When the railroad repair plant is given the same acid test that the modern industrial production engineer applies to the manufacturing plant the railroads are going to discover that the margin between profit and loss is today so narrow that obsolete methods and facilities can no longer be tolerated.

Spray Painting Car Equipment

The spray painting of railroad cars, both passenger and freight, is now being carried on successfully by many roads, and undoubtedly this process will be used even more extensively in the future. Marked economies are effected in the labor cost of application, far more than offsetting a somewhat greater amount of paint material used, part of which may be charged to the application of heavier coats, which fill all cracks and crevices and have a proportionately greater protective service life. Another factor of great importance is the general reduction in time required for painting operations, and the consequent reduced shopping time and more prompt return of equipment to service. While not a vital consideration at present, with the reduced demand for equipment, this factor is bound to be increasingly important in the future.

Among several roads quick to appreciate the possibilities of spray painting was the Chicago, Milwaukee, St. Paul & Pacific, which carries on heavy car maintenance operations primarily at the system shops, Milwaukee, Wis. It was not until something over a year ago, however, that these shops, in both the freight and passenger departments were furnished with suitable paint spraying equipment and exhaust hoods for the most satisfactory and general use of spray painting. The results secured in spraying freight cars will be discussed in a subsequent issue of the *Railway Mechanical Engineer*. The results with passenger equipment described in an article elsewhere in this issue, may be summarized as a saving of over $12,000 a year by the installation of equipment at a total aggregate cost of slightly over $37,000. This saving was accomplished while working an average of only four days a week and will, of course, be proportionately increased when the shops are returned to full-time operation.

The study of paint spraying operation and costs at the Milwaukee passenger shops of the C. M. St. P. & P., presented in this issue, is believed to be one of the

most comprehensive and informative investigations of its kind yet made and worthy of the closest scrutiny by all car men interested in more economical and satisfactory painting of passenger equipment. The study apparently proves beyond question the advisability of supplying passenger shops with necessary spray painting apparatus and ventilating systems to eliminate the health and fire hazards, so that the economies of this method of paint application may be made available to the railroads. The installations, when properly made as in the case of the Milwaukee shops, receive the approval of fire underwriters, state health and labor departments and promote greatly improved working conditions in the paint shop. As shown in the article, the spray painting of cars at Milwaukee shops during the test period resulted in a reduction of 50.4 per cent in man-hours and 54.2 per cent in direct labor costs. This was accompanied by a 9.8 per cent increase in paint materials per car only a negligible proportion of which, however, can be accurately classed as waste. Other attendant advantages of spray painting are clearly indicated in the article.

Obsolete Shop Equipment

Shop equipment, whether it be machine tools, material-handling equipment or small tools that can no longer be classed as modern, is a distinct liability in any shop. In times when earnings are high shop facilities that have passed their period of greatest economic usefulness are tolerated because the service that they can render, unsuited as it is to modern production demands, is needed. When railroad business conditions are as they have been for the past year, the up-to-date shop supervisor should be checking up pretty carefully on the operating costs of individual units in his shop in order to determine the actual savings that could be effected by their replacement.

An American business man, writing recently on industrial conditions, mentioned the fact that there are many industrial plants in this country and many individual units of equipment in some modern plants that can never be economically operated again because competition and the readjustment of prices will force production costs in the future to be reduced to such an extent that obsolete equipment cannot meet the output demand at a cost which will permit a profit. Many railroad shop men have felt that the need for shop equipment of the most modern design was not justified in a railroad shop because the shop is not engaged in the manufacture of a product which is sold in keen competition and, therefore, the production costs need not be watched as closely as would be necessary in a manufacturing plant. This is not true today. The product of a railroad is transportation and today rail transportation seems to be the object of the keenest competition in our recent industrial history. It seems fairly certain that even the return of better business conditions will not restore to the railroads the increasing annual revenue that has come their way for many years in the past.

The maintenance of equipment—locomotives and rolling stock—requires approximately one-third of all the money spent by the average railroad for operation and it is in the constant reduction of unit costs of operation that the railroads should have the greatest hope for increasing profits from rail-line operations. Mechanical-department officers have demonstrated that it is possible to haul longer trains with modern locomotives at substantial savings in operating costs and it is up to the mechanical-department supervisor to demonstrate that this modern power can be maintained in such a manner that no part of the savings made in operation will be absorbed by higher maintenance costs. Modern trains are not being hauled by 30-year old locomotives and it is not reasonable to expect that modern locomotives can be efficiently and economically maintained by obsolete shop equipment.

Foremen's Responsibilities Increasing

The responsibilities of a railway shop foreman in any department are already legion and may be said to be on the increase, because of the increasing necessity for economy and improved standards of maintenance. The provision of safe working conditions and the attainment of efficient operation are two of the most important of a foreman's responsibilities. With regard to safety, the records in accident prevention, established at many shops, engine terminals and car repair tracks during the past year are a glowing tribute to the way in which shop equipment and maintenance practices have been gone over with the utmost care to eliminate any conditions tending to promote accidents. Reportable accidents have been cut at some shops to an almost negligible quantity and steps taken to sustain the interest so that there may be no return to former undesirable conditions. In this work, the shop foreman and gang leaders are in the last analysis the most important factors, as it is by their encouragement and the inspiration of their example that shop men are induced to work together for safety and take drastic action in the case of individual workers who seem disposed to be careless about their own safety and that of the men who work with them.

Safety and production are closely allied, and it may be said without fear of successful contradiction that no shop in which unsafe equipment and hazardous methods are tolerated can produce the desired results with respect to output. Here again, the shop foreman or supervisor is the primary factor. The successful foreman attacks with energy and persistence both of these problems of safety and production, making the most of such facilities as are at hand, and, at the same time, does not neglect to bring the needs of his department, in the way of improved machinery and safer equipment, to the attention of higher officers repeatedly, until such time as these needs are met. In these columns last month the opinion was expressed that higher railway officers should require shop foremen to justify the continued use of old, worn-out and antiquated machinery, instead of making them fight to get it replaced, as so frequently happens. Until such a policy is adopted, however, the shop foreman is not discharging his full responsibility so long as he passively acquiesces in the decision not to purchase new equipment which he knows will promote safety or effect substantial savings in shop operation.

Another primary responsibility of a shop foreman is, of course, to study men, learn their idiosyncrasies, deal fairly with them and thus encourage a feeling of respect and a willingness to offer suggestions for improvement which generally are obtainable in no other way. The foreman must, obviously, not only know how work in his department should be done and how long the individual operations require, but above all acquaint himself with the respective abilities, temperaments, initia-

tive, etc., of the men working for him, and in this way be in a position to promote or recommend for promotion the future supervisors. It is recognized that the workman of today is the foreman of tomorrow, and one of the most important duties and responsibilities of present foremen is to take pride in developing those who show signs of ability and loyalty to the interests of the company they serve.

Developments In Machine-Tool Design

Although there has been a marked decrease in the purchase of machine tools and shop equipment by the railroads during the past year, the manufacturers and builders have continued with unabated effort to improve their products and advance their designs for the purpose of decreasing railway shop production costs and increasing the serviceable life of repaired equipment. The outstanding developments in the refining of machine tool design have been greater ease of manipulation and further increase in the use of alloy steel and heat-treated parts to increase durability necessitated by the extended use of new cutting alloys. The wider use of anti-friction bearings and better lubricating systems is noticeable on practically all new machine tools designed during the past year.

The effect of the introduction of new cutting alloys on machine-tool design is noticeable in the decided trend towards the use of alloy steels in gears, spindles and all parts subject to wear and heavy stress. During the past year a lathe was introduced designed in its entirety for use with tungsten-carbide tools. The use of alloy steels in the design of this machine is indicative of the general trend. Grinding equipment for grinding tungsten-carbide tools was introduced by three manufacturers in the last six months of 1930, this also indicating the extended use of hard cutting alloys.

Practically all of the new machine tools are designed with lubricating systems to give either flood or full automatic lubrication, oil filterers of various kinds being incorporated in the systems to remove foreign matter. Considerable attention has also been given to the cutting-fluid circulating system with the objective of furnishing the fluid to the cutting tools in large quantities and of eliminating chips and dirt by the installation of filters.

There is a marked tendency on the part of the machine-tool builders to include alinement devices, some of which are used to check quickly the alinement of the machine as a unit and others for taking up the wear and alinement of parts.

A number of machine tools in which notable refinements were made were brought out since June of last year. Included in these is a 90-in. locomotive driving-wheel journal-grinding machine which is designed to produce a finished journal in 40 min. floor-to-floor time and to do work of such quality that the service life of the journal itself as well as the axle is increased. A 90-in. crank-pin quartering machine designed to quarter driving wheels to close tolerances was also introduced. This machine was designed to eliminate guess work in the quartering of driving wheels, thereby permitting closer work in the alining of side and main rods, and increasing the service life of the rod bushings. Of particular interest is a car-wheel boring machine with rapid traverse controlled by oil pressure to obtain heavier feeds and faster production and at the same time eliminate feed gearing. This machine includes a number of alloy-steel parts and also has anti-friction bearings. Refinements in grinding equipment for finishing cylinder walls of air compressors, feedwater pumps, reverse-gear cylinders, fire-door cylinders, etc., were also made during the past year. In grinding equipment for this work attachments for producing accurate and finely finished boards have been brought out. One manufacturer brought out a machine for honing these cylinders which is designed to eliminate bell-mouthed and tapered cylinder walls.

Several manufacturers have designed automatic lathes, the tool or gang tool of which follows a template, the shape of which is the shape of the finished product. Jigs and fixtures have been brought out by manufacturers of milling machines and shapers to increase the adaptability of their equipment to railway repair work. One horizontal boring, milling and drilling machine was placed on the market, the main spindle of which gives 36 speeds in geometrical progression and which is designed with an auxiliary high-speed spindle mounted within the back-gear shaft of the main spindle to give an additional 36 speeds. Another manufacturer brought out a lathe equipped with a 16-speed triple-geared head with face-plate drive, the design of this latter machine provides eight out of the 16 spindle speeds through an internally-geared face-plate drive, the remaining eight spindle speeds being transmitted through the spindle gear. Another manufacturer introduced a welded band saw, the welding of the completed metal frame and stand being adopted to insure a machine which would be light in weight and rugged in construction, eliminating vibration and thus increasing the life of the saw blade.

During the past year there was considerable development in electric heat-treating equipment, melting furnaces, bar heaters and rivet heaters. The possibility of accurately controlling the furnace temperature has influenced a decided trend on the part of the railroads to adopt electricity for these purposes.

Refinements have also been made in welding equipment, extending the range of cutting and welding facilities. The increasing use of welding in the railway shops has also resulted in the design of many portable electric-welding machines, the trend in the design of this equipment being towards inherently-regulated single-operator machines. New machines for spot welding have also been developed.

There has been a marked development during the past year in various types of spraying equipment for the application of paints, varnishes and lacquers. Some of these are equipped with electrically-operated compressor units while others are equipped with gas-engine compressor units.

NEW BOOKS

THE CHEMICAL COMPOSITION AND PHYSICAL PROPERTIES OF HEAT-RESISTANT ALLOYS. *Reprint from the proceedings, volume 30, part 1, 1930, of the American Society for Testing Materials. Bound in cardboard, 6 in. by 9 in., 11 tables. Published by the American Society for Testing Materials, 1315 Spruce street, Philadelphia, Pa.*

The tables itemize the chemical compositions, physical and mechanical properties and corrosion-resistant properties of corrosion-resistant and heat-resistant alloys. The alloys are grouped according to manufacturer, listed alphabetically. The tables are split into six parts with an (a) and (b) section of each part, section (a) giving chemical compositions, and the physical and mechanical properties and section (b) the corrosion-resistant properties.

THE READER'S PAGE

Some Comments On Wheel Defects

To the Editor:

The letter on page 195 and the article on page 197 on wheel defects in the April issue were interesting to me. I believe the following statement of the causes of the various defects may be of interest.

Worn flanges are responsible for the removal of about 65 per cent of the cast-iron wheels and are caused from guiding the truck on the rail. Do we stop to consider, when a pair of wheels are removed for this defect, which have not run out the guarantee on the wheels, that there is some other mechanical defect on this truck, such as center casting broken or no lubrication, trucks out of square, side bearing riding and no lubrication, or wheels not mounted properly or not of the same tape size?

Brake burns are the cause for removal of a number of wheels each year. When a car is set out on the repair track for this defect, are the triple valve, brake levers and beams checked to ascertain that the brakes will not drag and again burn the wheels that are being applied?

Many wheels are taken out of service each year for chipped rims which are caused by striking high switch points and crossings. This defect is not as common in the single-plate wheel with the lip chill as on the double-plate with sand rim.

A small percentage of wheels are removed on account of broken rims, which are generally caused by a worn-through chilled wheel or a seam under the surface of the tread which cannot be detected until the wheel has broken.

The number of flat wheels removed has been reduced considerably in the last few years. Flat wheels are caused by one of four defects: Defective triple valve, too much braking power, hand brakes set, or wheels eccentrically bored.

Shelled out and comby treads are generally found on wheels that have been brake burned and run until spots are shelled out where the metal has cracked from the heat. One is found occasionally that looks like an oyster shell or a seam under the surface of the tread which is a foundry defect.

A cracked plate or bracket is generally found in a double-plate wheel about half way between the hub and rim or on the rim or outside plate. It is caused from a hot wheel on account of the brake shoe dragging. Very few defects of this kind are found in the single-plate wheel that has been generally adopted since 1928.

A few wheels are removed on account of cracked or broken hubs, which should be termed a wheel-shop defect. It can generally be traced to poor workmanship in the shop that mounted the wheels. It is also caused by heavy tonnage, tapered axle, wheel seat out of round, not properly lubricated at the press when mounted, and by boring out of round. The latter is caused by boring hard spots in hubs and hard hubs in one cut.

Steel wheel defects are similar to those in cast-iron or cast-steel wheels, except shelled treads. The cause of this defect has not been determined. It is believed that it is caused by metal being soft so that cold rolling on the surface sets in while in service. This starts checking and develops into progressive cracks that penetrate into the tread of the wheel and start shelling out. Relief from this trouble has been effected by using a better grade of wheels, such as those heat-treated in water or oil. In some service cold-rolled treads have given relief to shelled-out trouble.

Gas pockets or pipes, seams and shattered rim, if found under the surface of the tread, are factory defects and such wheels should be set to one side and held for the factory inspector.

J. R. Dunn.

Limited Use of Free Oil Defended

To the Editor:

The controversy regarding the use of free oil for supplementary lubrication of freight car journals is a very old one and each side has its advocates. Since there are a hundred or more conditions which separately, or in combination, may cause car journals to run hot, it is obvious that the injection into boxes of a small quantity of free oil will not eliminate hot-box trouble. On the other hand, a limited amount of free oil, intelligently used, will help reduce hot-box troubles that are directly attributable to the sponging being deficient in oil content; also, a surplus of oil may prevent boxes running hot due to disarranged packing, and other conditions that tend to restrict free lubrication. Local conditions, however, should govern, for while on the one hand free oiling will inevitably result in oil wastage, yet on the other hand its use may result in a sufficient reduction in hot-box train delays to justify such a course.

After boxes had been properly overhauled and repacked according to Rule 66, intelligently performed periodic respooning is the best hot-box preventive measure. Since the sponging suffers many times more disarrangement in cold weather than in warm weather the spooning attention will necessarily have to be at much more frequent intervals during cold winter months, and where temperature is cold enough to freeze the packing in a standing car the spooning should be done as soon as possible after the arrival of the car.

Sometimes the importance of making a good oil record in connection with journal-box repacking is overemphasized, resulting frequently in a deficiency of oil in packing, and at times even to a deficiency of packing in boxes. In such cases the normal oil losses may reduce the oil content to the danger limit before the next repacking date.

Free oil should be used sparingly and then only in such boxes as show evidence of a shortage of oil. Careful instructions to oilers, and a thorough supervision of their work, are necessary to prevent gross abuses where free oiling is practiced. Laying a pad of wet waste against the upgoing side of a journal is a small sop of oil to the box, and a sop to the conscience in not calling it "free oil." Such a practice is bad in that this loose and separated piece of packing is too easily dislocated, and the result is bound to be an abnormal number of waste-grab hot boxes.

It is well known that new sponging, either cotton or wool, becomes disarranged in the box much more readily than old packing. A good practice is to mix old and new packing. The presence of unspun fluff and short fibres in cotton waste is a prolific cause of waste wipes—small isolated particles of waste carried up under the

edge of the journal bearing forming a wiping pad. This trouble is particularly pronounced during cold weather, when the oil becomes a partly congealed, sticky mass, which drags these loose particles on the upgoing side of journal.

The best wool waste for use in cold climates is one composed of long strands of a hard weave material. Soft weave yarns and short strands are the chief cause for waste wipes, probably responsible for most of the hot boxes where wool waste is used.

While we are discussing lubrication of freight car journals why not start something on car oil? Since boxes are repacked only once a year, why two oils, summer and winter?

CAR DEPARTMENT OFFICER.

Comment on Standard Side-Bearing Clearance

TO THE EDITOR:

In the March issue of the *Railway Mechanical Engineer* a question was asked and answered by "A General Foreman"; "What is Standard Side-Bearing Clearance?" I wish to take exceptions to the definition of side-bearing clearance as described by the writer of the article.

In the first place the clearance of $\frac{1}{8}$ in. to $\frac{5}{16}$ in. is *per side bearing* and not per truck. Under no consideration should a truck have a flush side bearing, regardless of the fact that the other bearing may have the proper clearance. A flush side bearing will cause uneven distribution of the load, will cause journals to overheat and will cause undue flange wear on the wheels, and sometimes break off the flange or the lug on the journal bearings. A car with a flush side bearing is very susceptible to derailment, especially when entering or leaving a curve.

Side-bearing clearance should be kept to the minimum on house cars as they are most susceptible to car-body roll. Clearance should be as near equal as possible on all bearings so as to synchronize the car-body roll on both trucks.

JAMES MCDONNELL.

An Answer to "Setting Southern Valve Gear"

TO THE EDITOR:

The Reader's Page of your May issue has a request for information on Southern valve gear. This man does have some marks that are confusing. I am of the opinion that this engine has had the valves set too many times by trailing the engine over.

The setting of valves is not a difficult process, but a very expensive one if it is to be guessed at and trailing over is one of the best guessing methods used. It is used for speed so as to be sure to get it all wrong and not know it at the time. After setting valves for several years and having considerable experience as a foreman, I am more than ever convinced that it is all guesswork. Trail an engine over, get some marks, make some changes, not knowing how the eccentric crank arms are, or the position of valve at dead center, or the amount of travel in front and back motion on both sides, and the engine goes out. It cannot be right. The man setting the valves has done a lot of work, but invariably it has to be done over.

The first operation in setting of valves is to see if all parts check to blue print sizes. Check this engine over with the blue print and the trouble will be located. Then get the dead centers, checking the travel on both sides as to lead and full travel, then the trouble can be located and the correct valve changes made. After this is done, the engine goes out and beats square, handles the train right and, most of all, saves coal.

Mr. Martin writes, "We understand the Walschaert and the Baker valve gear, but the Southern valve gear is different." There is one place that all valve gears are alike and that is when you have them on dead center. At this point, irrespective of the type of gear, the number of levers, or the source of motion, the valve must be at a certain place with relation to the port opening. Different types of gears have great claims over other types. Some have greater port openings, some have greater valve speeds, and so on. All the valve setter has to do is get the valve to open the same at all four points and he is done, providing all parts check to blue print size.

R. J. HALL,
Foreman, Missouri Pacific.

It Pays to Study Chill Worn Wheels

TO THE EDITOR:

The article on wheel inspection by D. M. Raymond, page 197 of April issue was very interesting to a man who handles wheels, but I cannot agree with Mr. Raymond on the worn-through-chill defect. If the inspectors depend on a loose box bolt or lid to indicate a chill-worn wheel, I believe that a good many wheels will be taken out of service that still have a lot of service miles left in them. If a wheel has started to wear through the chill, it can be detected by noting the height of the flange in three or four places on the wheel. Also, by noting rail worn marks on the tread of the wheel, it will be found that on a soft spot the rim of the wheel will look as if it is spreading out, or flaking off on the rim.

I think you will agree with me that it requires a car inspector of experience to find a chill-worn wheel in the first stages of wearing into soft iron. Supervisors, inspectors and carmen apprentices, the future inspectors and supervisors, should be sent to the wheel shop at regular intervals to inspect wheels that have condemning defects.

It is commendable practice to set aside brake-burnt, comby and shelled-out wheels and to break a few of them in two in order to acquaint supervisors, inspectors and apprentices with the depth of a brake burn or a heat crack in the tread of the wheel. You will find a very interested group of men when you get them together with a competent wheel man for this purpose and the time spent will more than be repaid in material and labor saved.

CAR INSPECTOR.

DOUBLE HEADLIGHTS.—Probably the only locomotive ever operated in this country with two headlights was the New York, New Haven & Hartford's old No. 129, which pulled the famous New England Limited, the "Ghost Train," on its nonstop run from Boston to Willimantic, Conn. The chief reason for equipping this engine with two headlights was to distinguish it as a limited train, one of the first by the way, in this country. The lights were mounted side by side on top of the smokebox, in front of the smokestack.

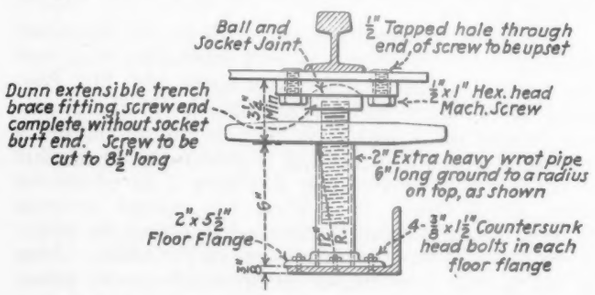
With the

Car Foremen and Inspectors

Florida East Coast Wheel Shop is Well Equipped

A BRIEF description of the wheel shop of the Florida East Coast which is located at its Miller Shops, St. Augustine, Fla., was published in the April, 1931, issue of the *Railway Mechanical Engineer*, page 181. This description showed two interior views of the shop and gave a complete list of the machine tools and equipment used in the shop. This list included a wheel-starting press which is used in connection with a Niles 400-ton wheel press.

A double-tier axle rack is centrally located with respect to the axle lathes, which are grouped together. Axles are handled from the lathes to the rack, and vice versa, by means of jib cranes. A 3-ft. track over which a light four-wheel truck is operated, extends from the storage rack at the axle lathes to another axle rack at the wheel-starting press. The construction of the axle rack located in front of the wheel-starting press is shown in one of the drawings. Two other racks for unmounted wheels, also shown, are located in a convenient position for handling the wheels to the adjustable section of the rack.

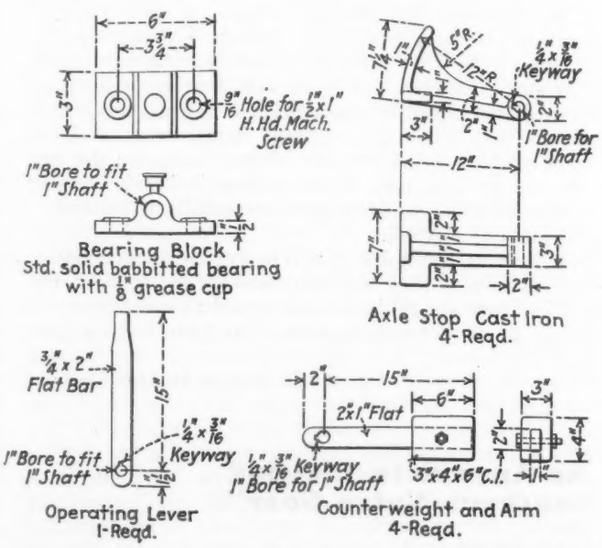

Ball and Socket Joint
½" Tapped hole through end of screw to be upset
Dunn extensible trench brace fitting, screw end complete, without socket butt end. Screw to be cut to 8½" long
½"x1" Hex. head Mach. Screw
2" Extra heavy wrot pipe 6" long ground to a radius on top, as shown
2"x5½" Floor Flange
4-⅜"x1½" Countersunk head bolts in each floor flange

Jack for adjusting the height of the axle rack

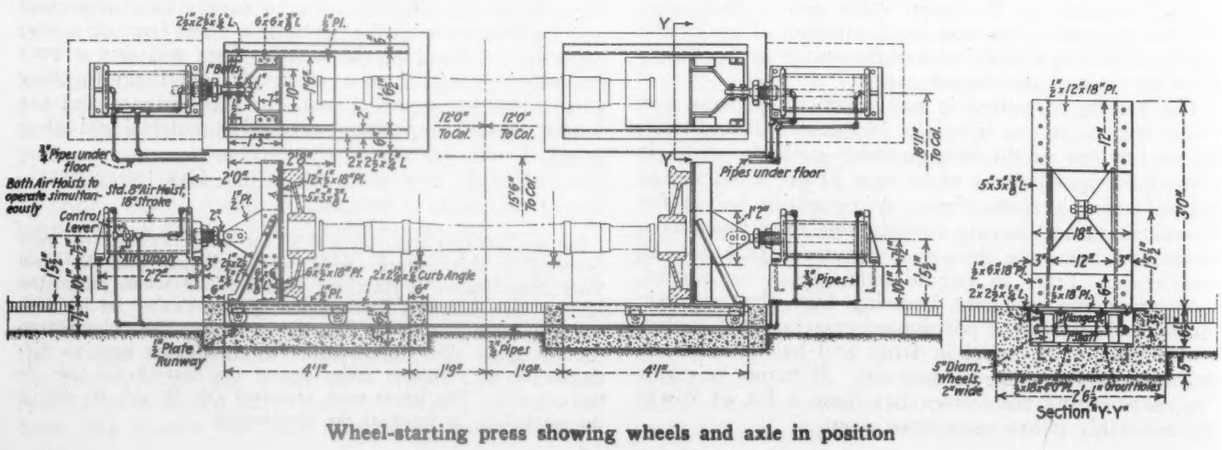
Axles are rolled from the truck directly on to the rack. The opposite end of the rack is adjustable for height. This is accomplished by hinging the rails, and providing two small jacks, the construction of which is also shown, under each rail. Four counterweighted stops are provided, two of which prevent the axles from rolling from the rack onto the adjustable section until required, and two prevent the axle from rolling off the rails. The adjustable section of the rack is adjusted so that the ends of the axle to which the wheels are to be applied are directly opposite the wheel bores.

The rack for unmounted wheels is designed to facilitate the handling of wheels from either side with a minimum of effort. It is constructed of ½-in. by 2¼-in. steel bar, the guide bars being spaced 8¼ in. apart. A bar on which each wheel rests is provided in each space. This bar protects the flange and tread, keeps the wheel erect, and facilitates the handling of wheels to and from the rack.

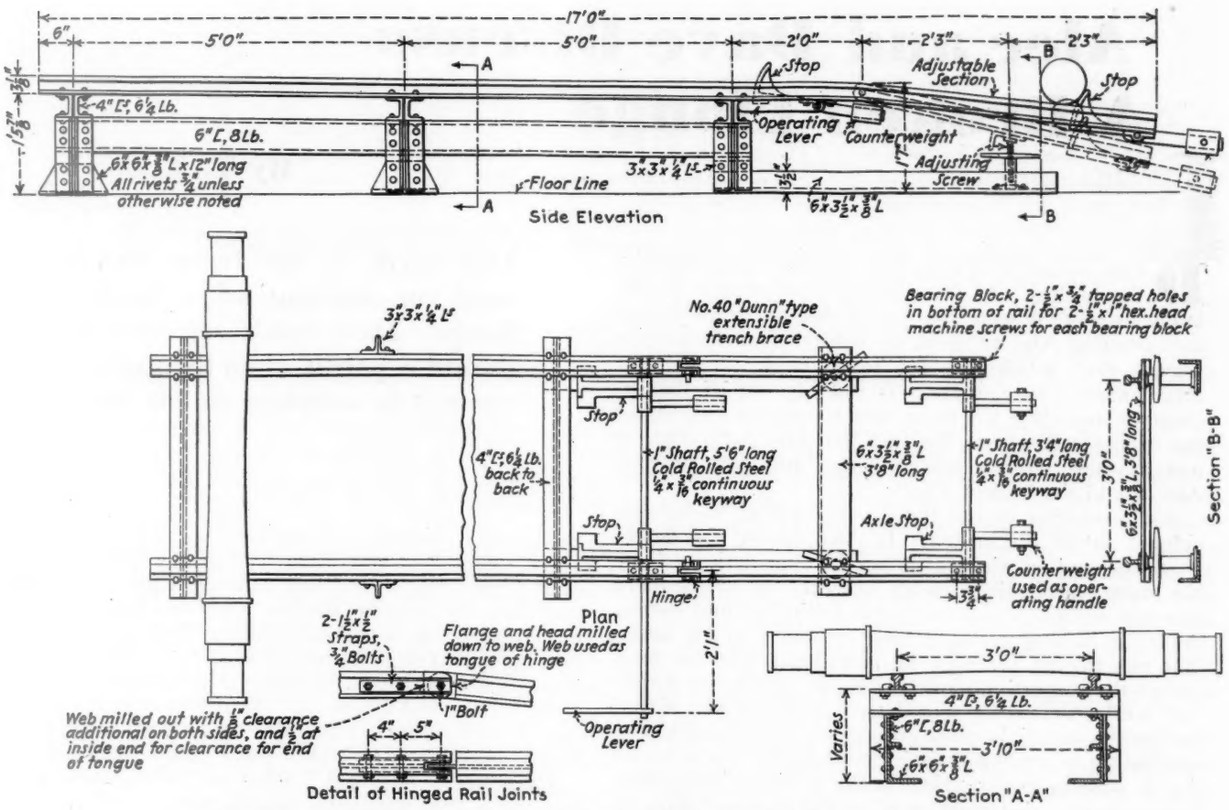
The wheels are placed over the journals of the axle at the rack as described and rolled on to the wheel-starting press, as shown in one of the drawings. The



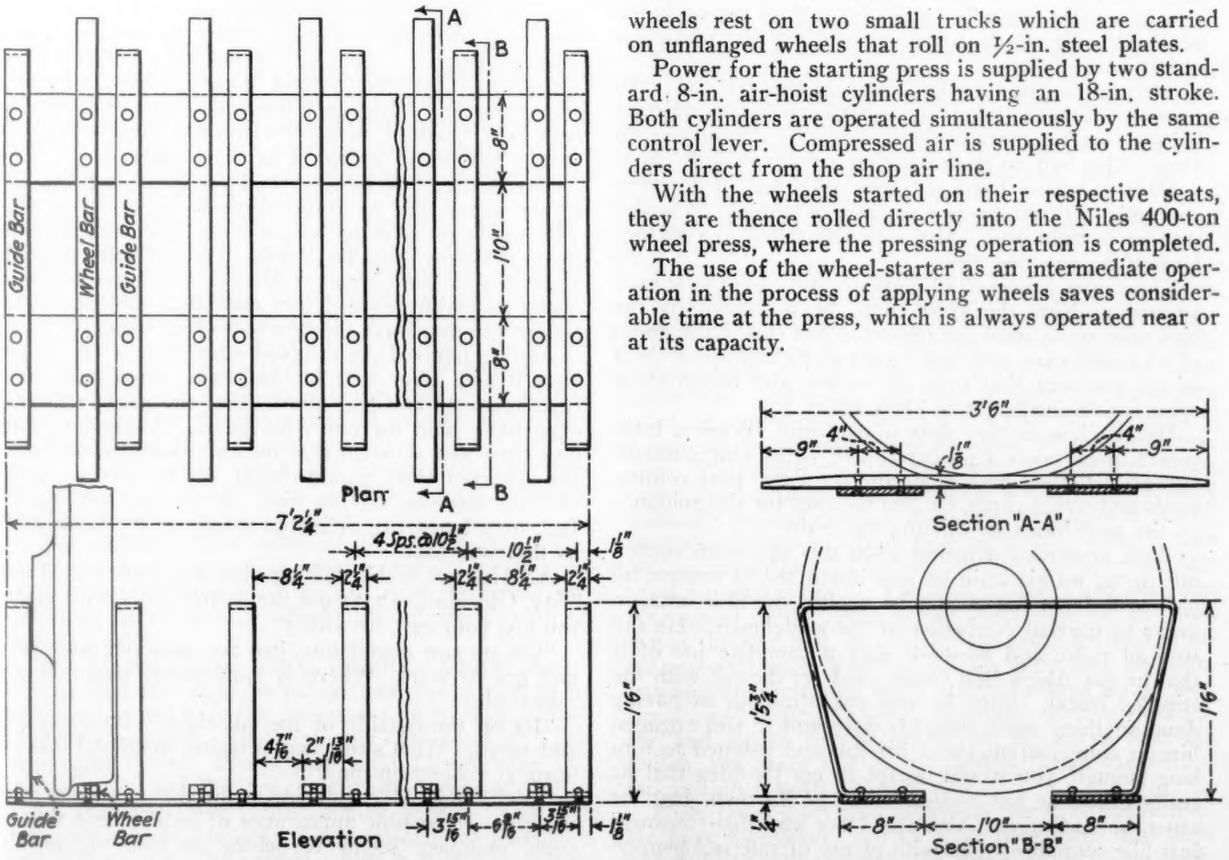
Details of the counterweighted stops of the axle rack



Wheel-starting press showing wheels and axle in position



Detail construction of the axle rack located in front of the wheel starting press



Rack for storing unmounted bored wheels awaiting application to the axle

wheels rest on two small trucks which are carried on unflanged wheels that roll on ½-in. steel plates.

Power for the starting press is supplied by two standard 8-in. air-hoist cylinders having an 18-in. stroke. Both cylinders are operated simultaneously by the same control lever. Compressed air is supplied to the cylinders direct from the shop air line.

With the wheels started on their respective seats, they are thence rolled directly into the Niles 400-ton wheel press, where the pressing operation is completed.

The use of the wheel-starter as an intermediate operation in the process of applying wheels saves considerable time at the press, which is always operated near or at its capacity.

Alec and Dave Discuss A Broken Flange

By T. J. Lewis

Alec cards a car from Dave's road on account of a broken flange. Dave can't see why he should repair it when through an error it is switched to his track

DAVE surely must have seen the new moon through the bushes. At least he has had enough trouble lately to make it seem so. In an inbound train yesterday morning Alec received an empty car belonging to Dave's road which was due to go home through the interchange. Sure, there was nothing out of the ordinary about that, but there was something very much out of the ordinary in the fact that this particular car had a wheel with a broken flange and part missing. Alec found the broken wheel.

As to whether or not there was anything to be considered out of the ordinary in Alec finding the defect would depend on who was doing the considering. Now the master mechanic probably wouldn't see where there was any excuse for an inspector failing to find such a defect if he was giving proper attention to his work. The general car foreman, if he had not been too long out of the inspection game, would be somewhat doubtful; while Alec, if he should have failed to find it and had gotten in a tight place on account of it, would have coupled up to a whole train of good arguments to prove that it was the easiest thing in the world to overlook a broken flange, and right next to the hardest thing to find one. Anyway, he hadn't missed this one, and call it good luck or just ordinary good inspection, as suits you best, Alec mentally patted himself on the back and resolved to be a little more watchful for that particular defect in the future.

Alec put a "Bad Order" card on the car and went on with his work, intending to repair it before offering it home on the interchange, to avoid an argument with Dave. Alec had no desire for an argument with Dave.

Dave is rather hard to argue with and, being very energetic, will go to any amount of trouble to prove that he is right and—Alec says—as much to convince himself as any one else.

There was a new yard clerk on duty in Alec's yard yesterday. Now the yard clerk, be it known, is the bird who waits until the inspector has closed the doors of all empty cars, and then comes along and opens them to see for sure that they are empty and leaves them open for the inspector to close again.

He also has another duty to perform. When a train comes in he takes a pocket full of cards and a mouth full of tacks and goes along the train and puts routing cards and weigh cards, etc., on the cars for the guidance of the switchmen in shifting the train.

Well, yesterday morning when this new man started out to tag up his train he was instructed to remove all old cards from the cars as he applied the new ones, in order to prevent confusion of the switchmen. He did that all right, and he made such a complete job of it that he got Alec's Bad Order card off the car with the crippled wheel. Sure, he was not conscious of having done anything more than his duty and if you engaged him in conversation about his job and listened to him long enough, you would be apt to get the idea that he really thinks he has some troubles of his own. Just the same, he had mixed Alec and Dave and their business just like scrambled eggs with plenty of salt and pepper.

Alec's Bad Order card being gone from the car, the switch crew kicked it in on Dave's interchange track. Dave found it. And when he saw the broken flange, he stopped, took a good look at it, then got down closer and felt the broken surface with his hand, making doubly sure that it was nothing less than the subject of the car inspector's worst dreams, he straightened up and whistled softly to himself. His next thought was "where from and where to." Glancing over the side of the car he saw the "Home Mty" card, then going to the corner he found Alec's pool mark just a week old.

Dave put a "set back" ticket on the car first thing and put a big scare-crow wheel mark on the side of the car, over the defective wheel, with soft chalk, and then looked around for Alec. He soon saw Alec, several car-lengths down the track and coming towards him inspecting as he came. Dave whistled and gave Alec a vigorous "come on" signal with his arm. He intended to give Alec a good "ragging" about not finding the broken flange and then make him take the car back and make it safe by renewing that wheel, for surely he'd never accept it in that condition.

Dave's thoughts were so well occupied with his side of the game that he forgot entirely to consider what Alec might be thinking, but, in truth, Alec was thinking about the same thing Dave was. He had been watching Dave out of the corner of his eye and Dave's actions spoke as plainly as a defect card that something was wrong and that Dave thought he had it "treed."

Alec recognized the crippled wheel car before he got near it and knew that his bad order card must have been removed and had figured that the new yard clerk must have been the one who did it. Altogether, Alec was very well satisfied that the car had gone on home. He expected Dave would object, for he was a regular objector anyway, but let him. It was an owner's defect, on a home car, delivered safely on the home rails, so that was that.

As Alec got within talking distance, Dave called out, "Say, Old Man, what's got the matter with you? Have you lost your cud, or what?"

"Oh, no new complaints, just the same old ones, poor and got to work. Where is your worst pain today?" asked Alec.

"Its on the outside of me, all right," Dave replied, and asked, "What's the idea in trying to unload this old hospital subject on me?"

"Well," said Alec, glancing at the side of the car with the greatest possible appearance of indifference that he could assume, "seems to belong to you, tag on the corner says 'home empty,' and as for it being a hospital

subject, if it is, you being the doctor, and having the hospital, you'll naturally want to operate on it,—I would if it belonged to me."

"Well, it still belongs to you, all right. Just read that little prescription of mine on the other corner over there. And, say," Dave continued, "how many wheels do you require under 'em to run 'em now."

"O, from four up," said Alec, "the scale test car has only four."

"Well, this baby's got seven and a piece, and I'm not running it anywhere," Dave said, and continued, pointing at the broken flange, "just look here, Alec. How in the world did you miss seeing that or did you?"

Alec looked at the flange as if that was the first time he had seen it and said, "Huh, chipped, aint it?" His seeming indifference was beginning to get on Dave's nerves and Dave was getting hot. He snorted:

"Chipped, the devil! You want to call half the flange a chip, do you? Now let me tell you Alec, there's no use trying to start that soft pedal stuff, for it won't go. Get that straight, now. And the car is coming back to you, remember that."

"Why, Dave, you haven't a right in the rule book to set that car back. I had ordered it to my rip track when it came in, with all good intentions of repairing it before it was offered home to you, but someone has removed my ticket and now its yours," Alec said, adding, "Anyway, there's only a foot of the flange gone."

"Say----" Dave's voice was low but vibrant with suppressed emotion, "What'll you take for that silk lined plan of yours for getting rid of things you don't want? All you got to do is just say 'let Dave do it' and, presto it's done and you are out from under. Why you've got that lamp-rubbing guy skint ten car-lengths." Dave was looking at Alec with about the same amount of contempt that Mr. Goliath must have looked at David when David accepted his challenge to that famous scrap.

Before Alec could get started, Dave continued, "And as for what rights I've got in the rule book, I've got a right to refuse any car that I don't consider safe to handle and I sure don't consider this one safe, neither do you. It's just too much of a risk to handle all the way from here to my rip-track—"

"Yes, but Dave," Alec cut in, "every car you handle is more or less a risk and if you don't take any risks you don't do any business, and if you don't, somebody else will. If you wanted to avoid that, you should have stayed in the back shop at North Yard, then you'd only have your day's work to do, and you wouldn't dream about dragging brake beams and loose wheels. Of course, when you think about being responsible for the safety of a few thousand tons of freight and equipment, whirling through the country at forty miles an hour, it feels pretty much like its on your shoulders, but that and your pay-check is what you get for being a car inspector—."

"Yes, a mighty fine bunch of Dr. Alec's soft soap," Dave cut in, "but it ain't making me forget this old cripple, not a blame bit. You just read the first interpretation under Rule 2. That's the ground I stand on and its solid."

"Oh, I know, Dave, it says that Rule 2 gives the receiving line the right to refuse any car which in its judgment is not safe for movement on its line, but—"

"That's enough! That's plenty!" Dave cut in, "Just stop right there. That's just what I'm turning this car down on, and I've done it already, good and flat—"

"O, dammit, Dave," Alec almost yelled. Alec was becoming excited himself. "You can act the blamedest fool I ever saw. You grab a half a fact and yonder you go with it, to beat a printer's devil. That statement is in an interpretation and it is not in the rule at all and the rule is what we've got to go by. That same interpretation itself goes on to say that it concerns a defective weld in a truck side—no mention is made of a wheel."

"It don't make a blame bit of difference—" Dave got started again,—"which it is in. The interpretations are only supposed to be a clarifying of the rules, and that one says right there that I've got a right to refuse any car that's unsafe, or that I consider unsafe; all said in one clean cut sentence with a period after it and it means just what it says or it don't mean anything and if it didn't mean anything it wouldn't be there. Now there's no way in the world that you can get around that. It says, furthermore, that I'm to use my own judgment."

"All of which sounds mighty convincing to you, of course, but, in the first place, the makers of the rules were generous enough to suppose that you had judgment to use and, in the second place, Buddie, just turn back there to page 11 and read the third paragraph of Rule 2. You see it says, 'Owners must receive their own cars home for repairs at any point on their line, subject to the provisions of these rules.' Now I guess that cooks your goose good and plenty." Alec said this last with a finality that he intended should close the subject forever, but surely he should have known his old yokemate better than that, for Dave jumped right at the bait he had hung out, thiswise:

"Yes, that's it; just wait a minute right there; that last phrase of that paragraph, 'subject to the provisions of these rules,' why, Alec, that was put there to take care of just such old patients as this one you're trying to dump on me now."

"Not dumping anything," said Alec, "gave it to you in regular switching order, on its own wheels; and for that last phrase of the third paragraph of Rule 2, there is no provision in the rules that you could ring in on this case except wrong repairs, or unfair usage, or defective safety appliances, neither of which you claim. It's simply your own car delivered home on your own rails with an owner's defect. It's yours, you've got it and you can keep it—that's all."

"Give it to me safe and I'll take it," said Dave, "like it is I won't."

While they were in the argument, Dave's switch engine crew had set in a small bunch of empties on Alec's track and coupled up to pull their own, and began backing out with them at this juncture. Alec and Dave both involuntarily started with the cars. Neither one had given over, and it was not clear to either of them just what the next phase of the matter would be. Dave gave a stop signal several times but none of the crew saw him. They both realized that they should have made provisions against this car being pulled until it was definitely decided what to do with it, then have it moved very slowly and carefully to a rip track. Also it was not the usual time for pulling the interchange, and they were not expecting it. The broken wheel had been the rear wheel of the truck as the train came in, but now it was the lead and, of course, this made its staying on the rail extremely doubtful. They were both on edge, watching the defective wheel and Dave kept giving stop signals and hoping he would be seen. By this time the car had struck the beginning of the curve near the switch, the sharp end of the broken flange caught the rail and off it went onto the ties.

Then Dave went into action of the first magnitude. He gave "washout" signals with both arms and both legs so fast that he looked like a monstrous pair of scis-

sors hitting on six in high, and talk about cussin' by note! Dave's voice sounded like a buck dancer doing his stuff on the bass notes of a calliope. Meantime, the old car was thumping along on the cross-ties and getting nearer the end of them every foot. In his desperation or in the hope of making his signals more emphatic, Dave grabbed his hat in his hand and used it as a flag, and as he waved it wildly, a nail protruding from the side of the car split it wide open and took the skin off his knuckle at the same time. He didn't notice the skin until later. Finally, after what seemed ages to Dave, the switch crew noticed that something was wrong in the rear and got the engineman to stop as quickly as possible. But just as they came to a stop the derailed wheel dropped off the end of the ties and the old car careened over and the corner of it smashed a big hole in the side of one of Alec's empties that Dave's crew had just delivered.

It was plain enough all Dave's trouble now. Alec felt somewhat guilty, though he reasoned that it was none of his fault. Dave stopped and just stood there, his face turning all sorts of colors, shading off from one to the other. He was so mad he would not attempt to speak. After a few seconds he slowly walked across a couple of tracks and sat down on the end of a cross-tie and when Alec finally spoke Dave didn't even tell him who to go to.

It will take at least thirty days or a pay-day to make Dave quit wanting to murder Alec.

Decisions of Arbitration Cases

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Insufficient Information on Car Damaged Under Rule 44

Manufacturers Railway Company car 5067 was damaged on or about April 16, 1929, and was repaired by the Texas & New Orleans at Ennis, Texas, September 17, 1929. The defects were claimed to be both old and new and the T.&N.O. billed the owner for repairing the old defects. The handling line stated that the car was loaded when it was delivered to it at Fort Worth, Texas, on April 16, 1929, and that a subsequent inspection showed that one side and intermediate sill, both metal body bolsters and body-bolster anchor straps were all broken, and were classified as old defects. The new damage consisted mainly of the other four longitudinal sills being broken. The handling line stated that it made every effort to develop the circumstances surrounding the cause of the new defects, but was unable to do so. In view of this fact it accepted the responsibility for the new damage as provided for in A.R.A. Rule 44. It contended, however, that the old defects existed before the new damage occurred, and that the owner should be billed for repairing the old defects in accordance with Rule 41. The owner contended that the T.&N.O. should carry the expense of all the repairs made, because they were unable to explain the circumstances surrounding the cause of the damage as required by Rule 44. The owner also pointed out that after the alleged damage occurred on April 16, 1929, the car was moved a distance of approximately one thousand miles before it was repaired on September 17, 1929. The owner brought out the fact that on May 24, 1929, the T.&N.O. reported the car under Rule 120, at which time it furnished a statement of the defects which did not enumerate whether they were new or old, but which it insisted was a condition which had been built up progressively by normal wear. As the car was reported under Rule 120, and since six broken sills were involved, resulting in a Rule 44 condition, the owner insisted under an explanation of the circumstances under which the car was damaged, but pointed out that the T.&N.O. was unable to furnish it.

The following is the decision of the Arbitration Committee: "Handling line has failed to furnish sufficient evidence to establish responsibility of car owner for the combination damage on basis of Rule 44. Rule 41 does not apply to such case. Handling line is responsible."—*Case No. 1659—Manufacturers Railway vs. Texas New Orleans.*

Defect Card For Boring Holes in Gondola Sides

Between July, 1926, and April, 1927, the Chicago & Alton received in interchange from the Elgin, Joliet & Eastern five gondolas in the sides of which holes were bored for securing lading. These cars were owned by the Missouri Pacific, the Minneapolis & St. Louis, the St. Louis-San Francisco, the Southern and the C. & A. When the cars were received in interchange defect cards were granted the C. & A. covering the holes bored in the siding. Each of the respective car owners repaired its car and rendered a bill against the E. J. & E. covering the repairs. The chief interchange inspector at Chicago issued offset defect cards against the C. & A. The C. & A. contended that A. R. A. Rule 32 (of the 1926 code), supported the issuance of the original defect cards, and stated that it was carded for similar defects at other terminals, and that they therefore had to protect themselves when receiving cars. The C. & A. also maintained that reference to Rule 4, paragraph 3, in support of the action of the chief interchange inspector as covered by File AC-1976-D, April 1, 1929, did not appear to be sustained in Arbitration Case 1516 which reads: "Rule 4 is intended to prohibit the issuance of defect cards for slight damage, that of itself does not require repairs before reloading the car, and is a measure for the guidance of inspectors in determination of responsibility, and should not be used for the purpose of invalidating a defect card issued in good faith and under the provision of the rules." The C. & A. stated further that it did not admit the original defect cards were issued in error, and further maintained that if they were in error, there could be no good reason why the car owner should not be held responsible, if the defects are considered car owners'. The C. & A. further contended that it did not damage any of the cars and should not be held liable for the cost of repairs.

The following decision as rendered by the Arbitration Committee: "That portion of Rule 32 of the 1926 and 1927 Codes, reading 'Removal or cutting out parts of car to facilitate loading and unloading,' was not intended to penalize delivering line for holes bored in sides of gondola cars to comply with A. R. A. Loading Rules requirements, and the rule was therefore amended in 1928 to definitely so indicate.

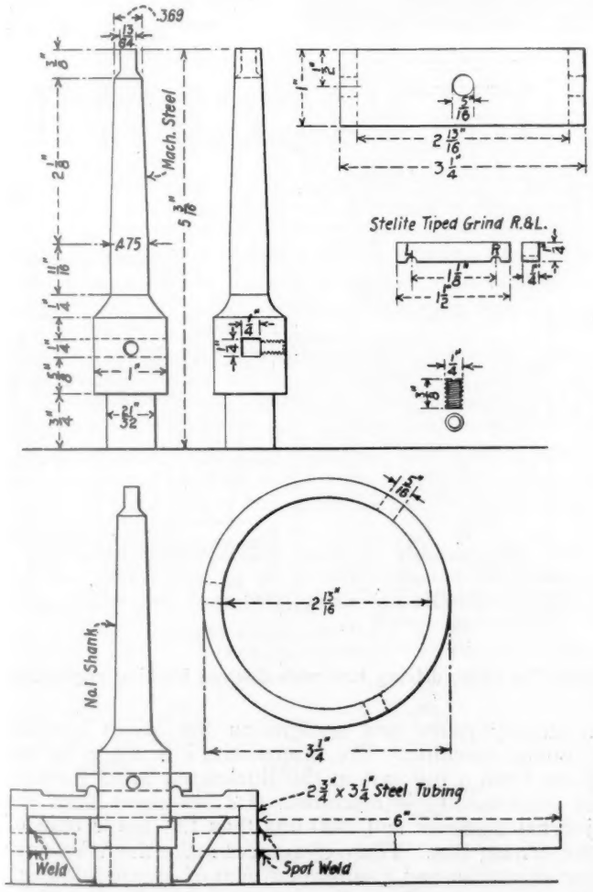
"The A. R. A. Loading Rules are a part of the Inter-

change Code, as stated in preface of the latter, and it would be inconsistent to penalize delivering line under the Interchange Code for doing what is required of it under the Loading Rules Section of the same Code.

"The issuance of a defect card by an authorized representative of a railroad is an acknowledgement of responsibility by the company issuing same which cannot be repudiated and leaves no ground for arbitration before the Arbitration Committee."—*Case No. 1660—Ex Parte Case—Chicago & Alton.*

Emergency-Valve Reseating Tool

A TOOL for renewing the emergency-valve seats of K1 and K2 triple valves is shown in the drawing. The tool was designed to eliminate the practice of attempting to reseat the valve with emery cloth since this



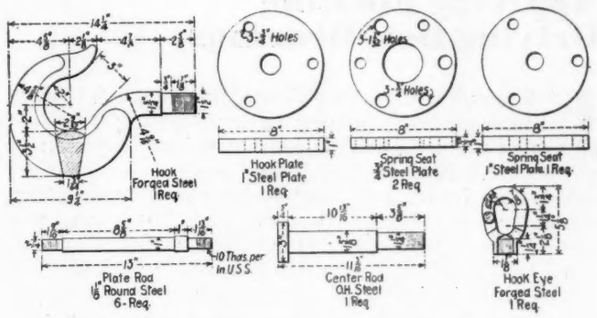
A tool for renewing emergency-valve seats of K1 and K2 triple valves

practice left the seat flat on the top instead of round, thus making it difficult to secure an air-tight joint when the rubber seat is applied.

When using the tool the emergency valve is placed in a holder and the tool is inserted in the spindle of a drill press, which is run at a speed of 100 r.p.m. The tool guide is entered in the valve and the tool permitted to run against the seat for a few revolutions until it is trued up.

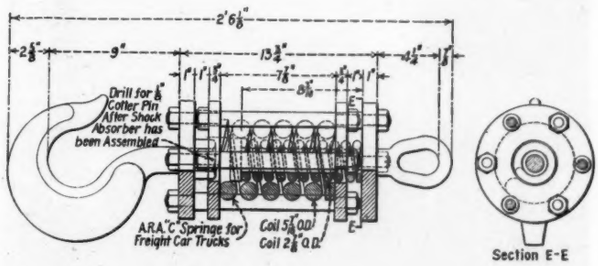
Shock Absorber for Five-Ton Jib Crane

THE shock absorber shown in the two drawings, is designed for 5-ton jib cranes. Shocks are absorbed by a single nest of class *C* A.R.A. truck springs. The coils are held in place by two circular


Hook Forged Steel 1 Req.
Hook Plate 1" Steel Plate 1 Req.
Spring Seat 3/4" Steel Plate 2 Req.
Spring Seat 1" Steel Plate 1 Req.
Plate Rod 1/8 Round Steel 6 Req.
10 Thds. per in U.S.S.
Center Rod O.H. Steel 1 Req.
Hook Eye Forged Steel 1 Req.

Details of the five-ton shock absorber

steel spring seats. The shock absorber is assembled by securing the hook plate to the top of the hook by means of a 1½-in. nut, which is held in place by a ⅜-in. cotter pin. The top spring seat, which holds the inner coil in compression against the bottom seat, is secured to the center rod by the hook eye. The top seat for the outer


2'6 1/8"
9"
13 3/4"
Drill for 1/8" Cotter Pin After Shock Absorber has been Assembled
A.R.A."C" Springs for Freight Car Trucks
Coil 5 1/8" O.D.
Coil 2 1/8" O.D.
Section E-E

The shock absorber for five-ton capacity jib cranes

spring coil and the outer spring are applied and the seat is secured to the hook plate by three plate rods. Three 1 1/32-in. holes are drilled in the top spring seat for the outer coil for the 1-in. plate rods connecting the hook plate to the seat. The outer spring coil carries the load, and the inner spring serves to cushion any upward movement.

BERTH OF A NATION IMPERILED.—Bedroom compartment cars, replacing old-fashion sleepers, threaten to put the upper-berth snoring champion on the shelf. New traveling boudoirs for tired business boys have all modern conveniences, including liquid soap, cozy reading lamps, chummy drafts and—to face towel kidnapers—hot and cold conscience twinges. There are also numerous little extras, the most amusing being the extra fare. Somehow we harbor an old-fashioned prejudice against the new hall room sleeping car. Modern luxuries creeping into our railroad systems may sap the ruggedness of the Yankee race, which thus far has been able to disrobe in a curtained chicken coop, remove its shoes while teetering on its collar bone, and get into its pyjamas like a democratic majority crashing a republican precinct. The American spirit, which conquered upper berths and Big Berthas, may lanquish when sleeping cars go kitchenette. While enjoying our modern blessings, let us not underrate the incentive to climb as a stimulus to human advancement.—Chicago Daily News.

In the Back Shop and Enginehouse

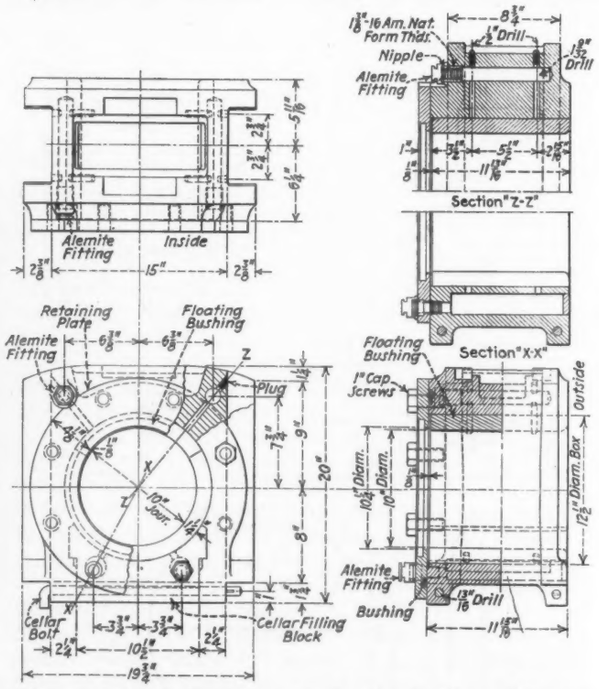
Applying Floating Driving-Box Bearings

FOR about a year, the Chicago, Burlington & Quincy has been using floating bushing driving boxes on all except the main driving journals of heavy passenger power, these main bearings being equipped with Grisco boxes. To install a floating bushing in a driving box, the old cellar is simply removed and the driving box slotted to receive a cellar filling block which is held in place by suitable shoulders and two cellar bolts. The driving box is faced off to receive a grease-retaining plate with a spring-supported brass expanding ring, which fits the journal closely and serves to retain the grease. The driving box, as well as the cellar filling block, is provided with grease cavities and drilled and tapped for the application of Alemite fittings with ports leading to the grease cavities. The fittings are screwed into the box and filling block and then spot-welded to make sure that they will stay in place. The proper side play is assured by welding on boiler-steel plates and facing off to the required thickness. Shoe and wedge ways are also built up to standard blue-print dimensions in the same manner. Spring saddle seats are built up by electric welding and machined square and at the proper height from the axle center.

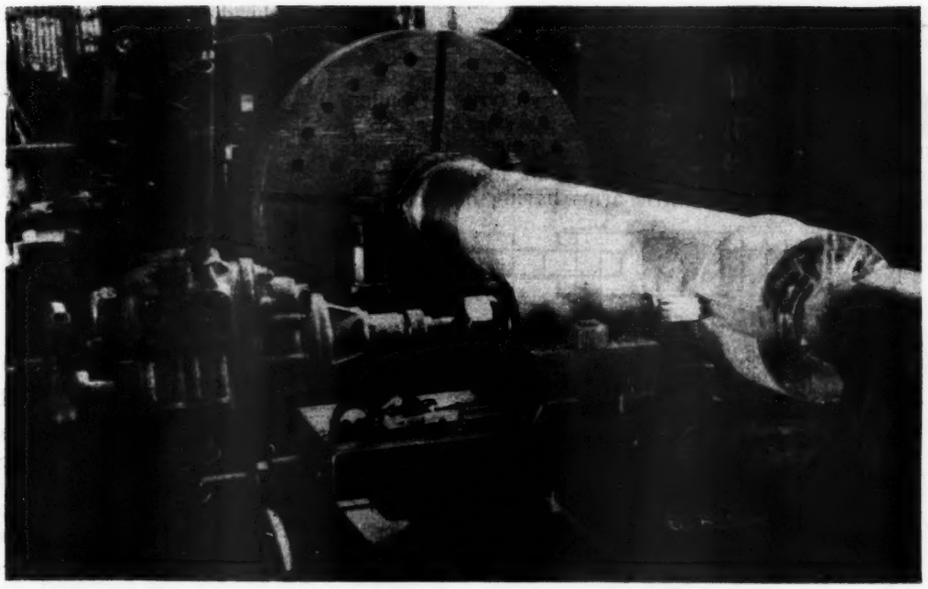
The inside surface of the assembled driving box and filling block is then bored to the proper size and ground accurately round and straight on the Micro internal-grinding machine. The bronze bushing, made in one piece from a tub cast in the Burlington brass foundry at Aurora, Ill., is machined .002 in. larger than the journal diameter and .030 less than the inside bore of the driving box. These clearances make due allowance for expansion and a substantial film of grease lubricant. The bronze bushing, after being machined on a 36-in. Bullard vertical turret lathe, is drilled and counterbored for grease holes, then being sawed into three equal sectors on a Brown & Sharpe knee-type miller, as shown in the illustration. The saw used is ⅛ in. thick; therefore, the total play of the three-piece bushing around the journal is ⅜ in., this space, as well as all the counterbored holes and all clearance space, being filled with grease by means of grease gun application to the Alemite fittings. Substantially greater service life is secured with this type of bearing as well as freedom from hot boxes and attendant difficulties in heavy, high-speed passenger service.

Sawing the finished floating bushing into three equal sectors for assembly around the journal in the driving box

Driving box, with filling block applied, being ground round and straight for the application of a floating bushing



10-in. by 12-in. driving box with floating bushing application



A milling device which is attached to the carriage of the engine lathe for cutting axle keyways without removing the axle from the lathe after it is turned to size

Cutting Keyways In Driving Axles

IN the drawings and photograph is shown a milling device for cutting keyways in the wheel fits of axles and also for the eccentrics of the Stephenson Valve gear. The device is mounted on the carriage of the engine lathe on which the axle is turned, thus permitting the milling of all the keyways before the axle is removed from the lathe.

In laying out the keyways the face plate or chuck is first quartered in the usual manner and the proper points transferred to the axle by using a surface gage for catching the points and a sharp tool or pointer in the tool post for marking the axle. This center line is also marked on the axle at the point where the eccentrics are to be placed, if it is the main axle and Stephenson valve gear is used.

In laying out eccentric keyways allowance is made for the actual amount of outside lap and the desired lead, taking into consideration the difference, if any, in the lengths of the rocker arms. In actual practice it is neccessary to add to this a small amount for the lost motion in the valve gear, this amount varying from a full thirty-second to possibly a full sixteenth of an inch, depending, of course, on the condition of the valve gear.

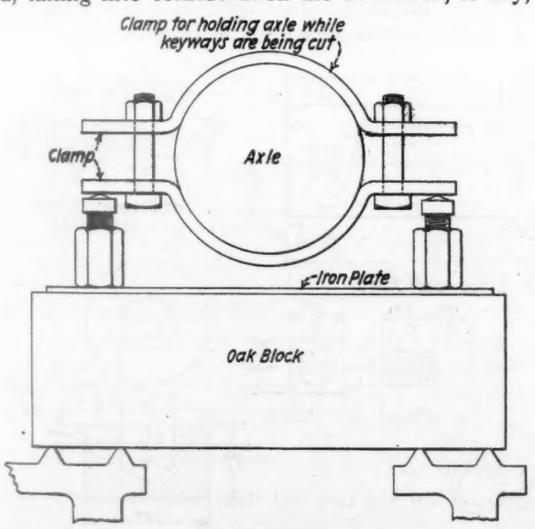
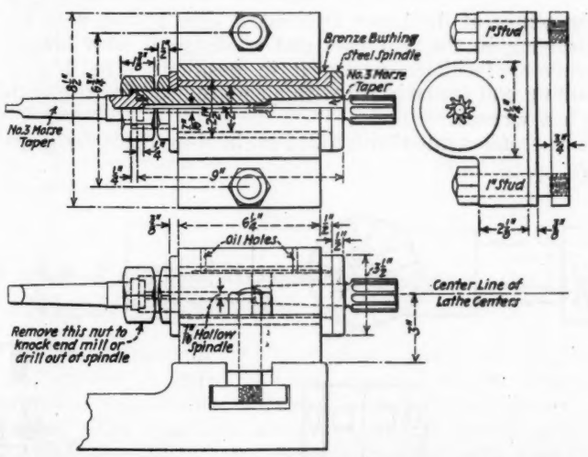


Table for laying out the keyways on the axles—The clamp for holding the axle while the keyways are being cut is shown

After the keyways are laid out, the axle, still on the centers, is clamped to the bed of the lathe to prevent it from moving. The end mill, attached to the lathe carriage, is used for cutting the keyways, an air motor being used to drive it. The desired feed of the milling tool is obtained by running the lathe and setting the feed of the carriage to suit. In cutting the keyways for the eccentrics, the end mill may be removed and a drill of proper size substituted for cutting the clearance for starting the milling tool.

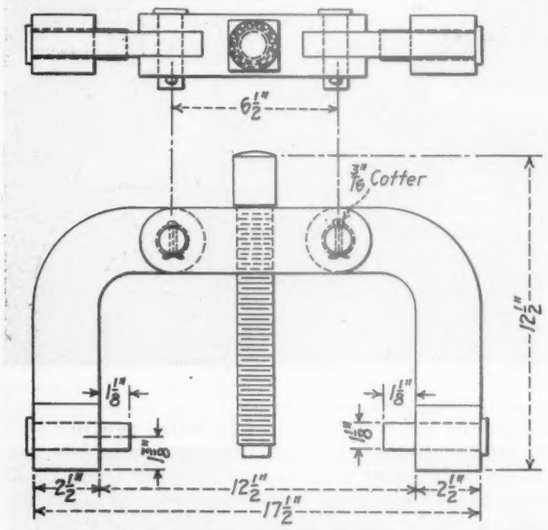


The milling device for cutting the keyways mounted on the lathe carriage

If the keyways in the wheel are carefully checked and the keyways in the axle cut accordingly, the crank pins will be in perfect quarter when wheels are pressed on. If the same care is exercised in checking and laying out the eccentric keyways, the eccentrics may be keyed in position before placing the wheels under the engine with the assurance that it will seldom be necessary to change an eccentric when setting the valves.

Eccentric-Crank Pullers

IN the two drawings are shown two types of pullers which can be used effectively for removing eccentric-crank arms. The one is 17½ in. long, 12½ in. wide between the pulling arms and 12½ in. high and is designed for use on eccentric arms having bolt holes in



An eccentric-arm puller designed for use on arms with holes at the center of the eccentric-arm hub

the center of the hub. It is fitted with 1⅛-in. pins for inserting in the bolt hole and is designed with hinged arms to facilitate setting it in position. The 1¼-in. pulling bolt is machined with a square head for use with a box wrench.

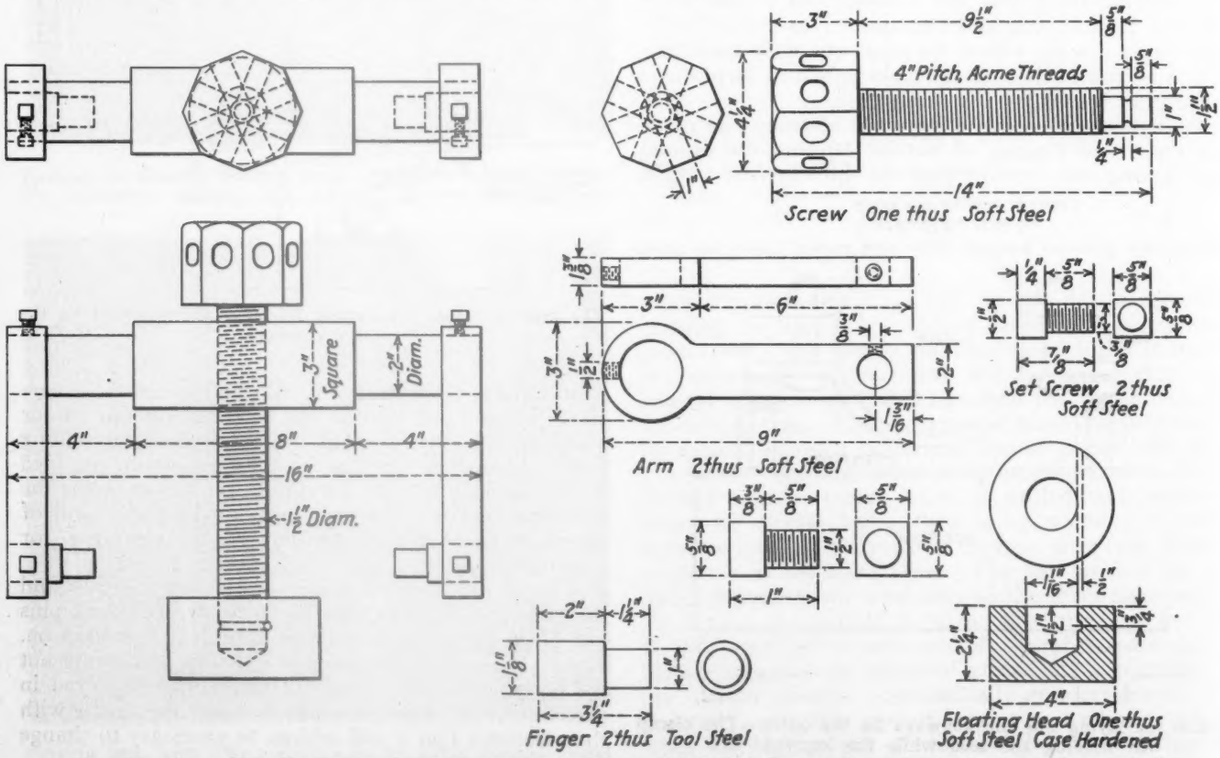
The puller fitted with a 2¼-in. by 4-in. diameter floating head set at the end of the pulling bolt is designed for removing eccentric arms with bolt holes at the end of the eccentric-arm hub. This puller is 16 in. wide and is fitted with a 1½-in. bolt. The arms of the puller are of 1⅜-in. by 2-in. soft steel and are bored to a diameter of 2 in. at one end for fitting them to the cross arm of the puller. They are held in position on the cross arm by means of ½-in. set screws. The fingers, which fit in the arms and which are inserted in the bolt holes, are 3¼-in. long, machined to a diameter of 1⅛-in. for a distance of 2 in. for fitting in the arms and to a diameter of 1-in. for a length of 1¼ in. for fitting in the bolt holes.

Air-Motor Drive For 100-Ton Norton Jack

SHOWN in the three drawings are the details and assembly of an air-motor drive designed for use with a 100-ton Norton jack. It can be used with one or two jacks. In case the latter arrangement is used a 24-in. extension shaft is provided. This shaft has sockets at both ends to fit a No. 4 Morse taper shank. Shanks are also provided, as shown, to fit the mandrel of the air motor.

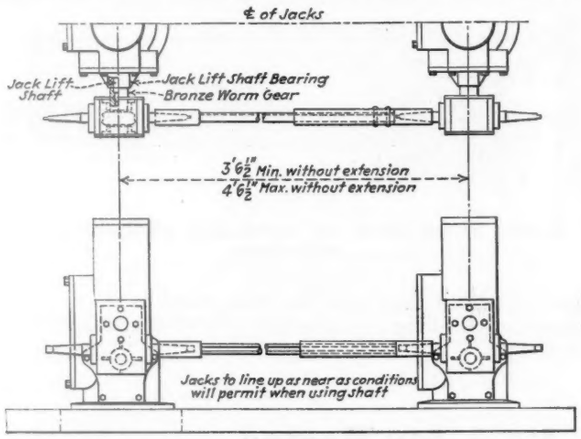
The air motor drives a bronze worm gear which in turn drives a pinion gear keyed to the crank-handle shaft of the jack. Each gear box is provided with two No. 4 Morse taper shanks which project on either side. The air motor or extension shaft can be applied to either shank as is most convenient.

The extension shaft has an adjustable range of 12 in., with a minimum length of 2 ft. 8 in. when closed and a maximum of 3 ft. 8 in. when open. The sleeve is made of 2-in. seamless steel tubing while the shaft is of round steel, machined to a diameter of 1.249 in. A $\frac{3}{16}$-in by ⅜-in. keyway, 17½ in. long is slotted along the shaft. A 4-in. key secures the shaft to the sleeve and prevents the shaft from turning in the sleeve.



A puller for use on the conventional-type eccentric arms with bolt holes at the end of the eccentric-arm hub

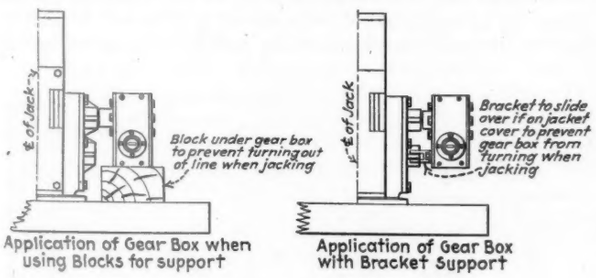
As shown in one of the drawings, the gear box may be applied to the jack with either a wood block for support or a bracket support. The detail construction of the bracket support is shown at the upper right


℄ of Jacks
Jack Lift Shaft
Jack Lift Shaft Bearing
Bronze Worm Gear
3'6½" Min. without extension
4'6½" Max. without extension
Jacks to line up as near as conditions will permit when using shaft

Two jacks coupled for power drive from one air-motor

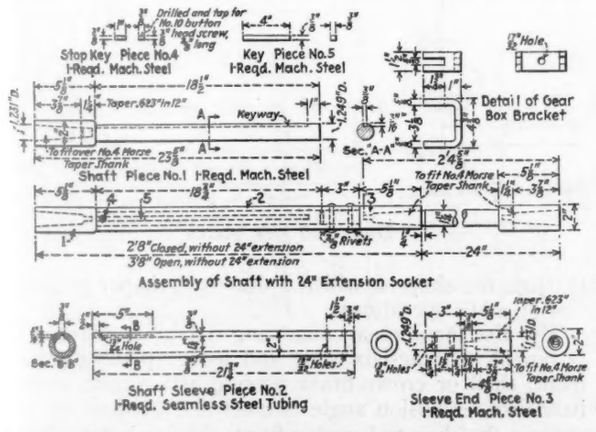
of the drawing showing the details of the extension shaft.

This air-motor drive has been successfully used for the past five years. The arrangement is such as to


℄ of Jack
Block under gear box to prevent turning out of line when jacking
Application of Gear Box when using Blocks for support
℄ of Jack
Bracket to slide over if on jacket cover to prevent gear box from turning when jacking
Application of Gear Box with Bracket Support

Applications of the gear box to the jack

facilitate the use of the jacks for practically all kinds of work where jacks of high lifting capacity are required. The fact that the air motor can be used on either side of the jack, or with two jacks coupled together, has been a distinct advantage. The two jacks

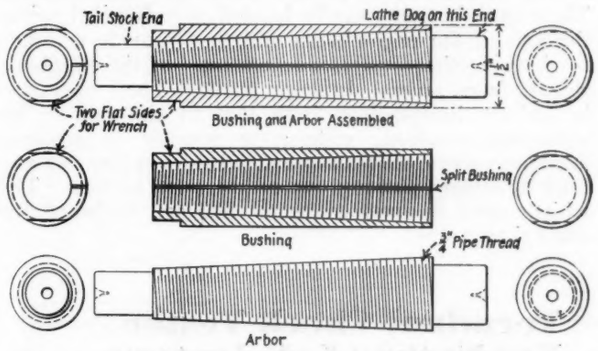

Stop Key Piece No.4 1-Reqd. Mach. Steel
Key Piece No.5 1-Reqd. Mach. Steel
Detail of Gear Box Bracket
Keyway
Taper .623" in 12"
Shaft Piece No.1 1-Reqd. Mach. Steel
2'8" Closed, without 24" extension
3'8" Open, without 24" extension
Rivets
Assembly of Shaft with 24" Extension Socket
Shaft Sleeve Piece No.2 1-Reqd. Seamless Steel Tubing
Sleeve End Piece No.3 1-Reqd. Mach. Steel

Details of the extension shaft and gear-box bracket support

coupled together with the extension shaft and driven by the same motor insures uniform lifting and lowering, a feature which is important in many instances.

Arbor with A Tapered Expander

THE expanding arbor shown in the illustration is designed with a tapered expander and a split outside sleeve, both fitted with ¾-in. pipe threads. When placing work on the arbor, the sleeve is inserted with the hollow piece to be machined and the tapered expander turned within the sleeve, the tightening of the expander exerting the necessary pressure to hold the work secure.



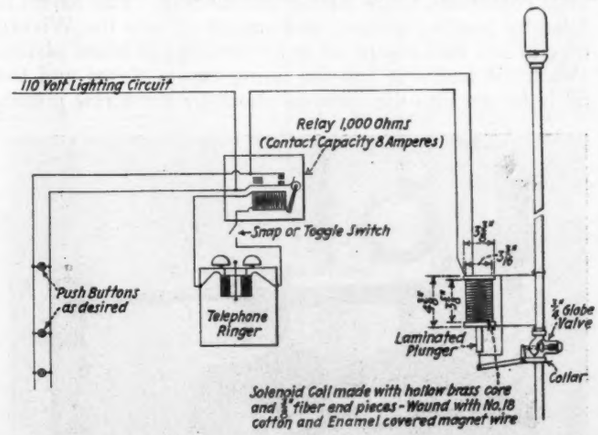
The arbor is designed with a split outside bushing and a tapered expander fitted with ¾-in. pipe threads

The large end of the tapered expander is placed toward the chuck-end of the lathe, thus creating a tendency to keep the work tight on the arbor while the machining operations are being completed.

The sleeve is machined with two flat sides on the end adjacent to the tail stock to permit the application of a wrench, which can be set against the lathe bed to facilitate tightening the arbor when setting the work and loosening it when the work is completed. The arbor illustrated is made with an outside diameter of 1½ in. Smaller sizes necessarily have less taper than the one shown.

An Enginehouse Signal Whistle

THE accompanying illustration shows an electric circuit designed to blow a signal whistle whenever the enginehouse foreman is wanted on the telephone. The apparatus consists essentially of two parts: A 1000-ohm relay, connected in parallel with ringing


110 Volt Lighting Circuit
Relay 1,000 Ohms (Contact Capacity 8 Amperes)
Snap or Toggle Switch
Push Buttons as desired
Telephone Ringer
Laminated Plunger
¾" Globe Valve
Collar
Solenoid Coil made with hollow brass core and ¾" fiber end pieces - Wound with No.18 cotton and Enamel covered magnet wire

Diagrammatic sketch of an enginehouse signal whistle which blows when the office telephone rings

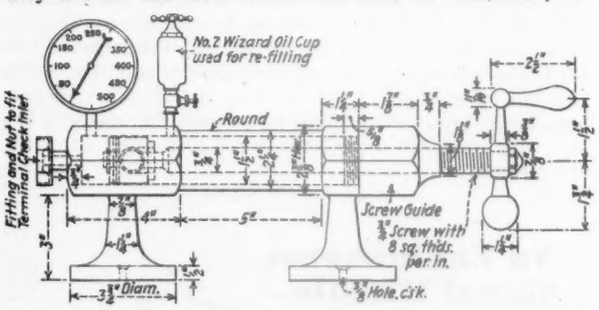
coils of the telephone and a solenoid for the operation of the valve in the air line. The armature of the relay is equipped with a roller on its free end and when the relay is energized, as it would be when current is applied to the ringer, this roller raises the lower member of a pair of contacts, thus closing the 110 volt circuit to the solenoid. A switch placed in the circuit between the telephone ringer and the relay permits the relay to be cut in or out as desired.

It will also be noted that there are a number of push buttons connected in parallel with the relay contacts. These push buttons may be located at convenient points throughout the enginehouse and they provide a means for blowing the whistle, independently of the telephone ringer, from several different points. Their operation is entirely independent from that of the relay. By arranging a whistle code it is possible to summon hostlers, callers, mechanics and other employees at any time by simply pushing one of the push buttons. The whistle used is operated by air and can be heard for more than a mile.

Terminal-Check Tester For Nathan Lubricators

By E. G. Jones

THE tester shown in the drawing is made to test and set Nathan terminal checks. This device can be used to test terminal checks at the repair bench or while they are on the locomotive. In case of the latter, the


No. 2 Wizard Oil Cup used for re-filling
Round
Fitting and Nut to fit Terminal Check Inlet
Screw Guide
⅜" Screw with 8 sq. thds. per in.
3½" Diam.
⅜ Hole, c'sk.

Assembly of the terminal-check tester

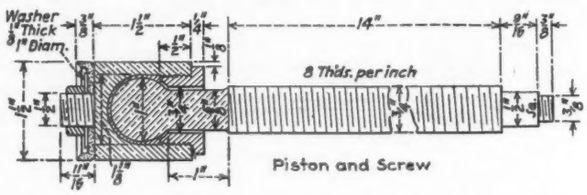
pipes are disconnected and the tester connected to the inlet connection.

The tester is of sufficient size and design to produce ideal conditions while testing the checks. The barrel is filled by pouring a heavy gas-engine oil into the Wizard oil cup and sucking the oil in by turning the screw piston. When the barrel is full the filling cup is closed and the oil is forced into the terminal check by the screw piston.

Terminal-check tester for Nathan lubricators

The pressure on the gage is noted and the proper setting of the check is made. The check diaphragm valve can be tested for leakage by noting the fall on the pressure gage.

The tester is made of brass, mounted on a small wood

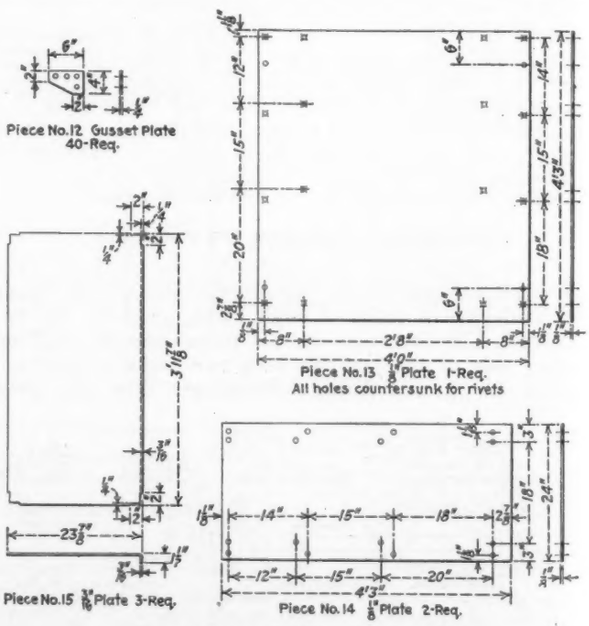


Section of the piston and screw used on the terminal-check tester

base to permit easy handling from place to place. The gage and oil-filling cup should be placed near the extreme end.

Rack for Morton Shaper Attachments

RAILROAD shops with one or more Morton draw-cut shapers have found it expedient to develop a variety of tools, jigs and fixtures for use with the machine. The shops in which the rack shown in the drawing is used, has developed or purchased 42 different tools and attachments to handle the work going

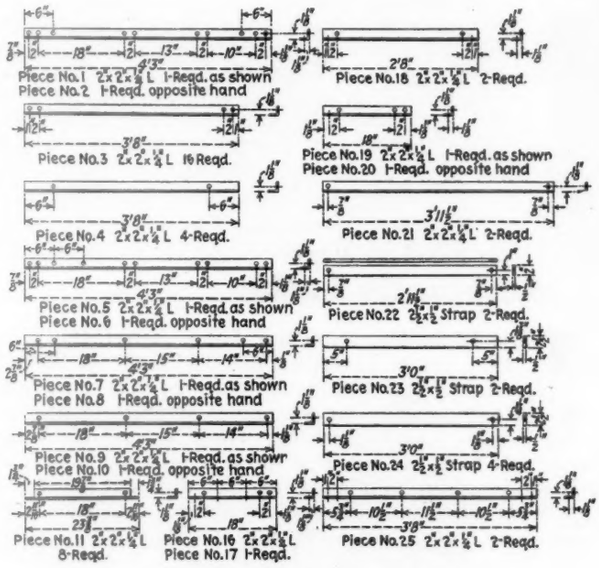

Piece No. 12 Gusset Plate 40-Req.
Piece No. 13 ⅜ Plate 1-Req.
All holes countersunk for rivets
Piece No. 15 ⅜ Plate 3-Req.
Piece No. 14 ⅜ Plate 2-Req.

Door and side plates

through the shop on which a draw-cut shaper performs one or more operations.

The list includes a connecting-rod brass planing attachment, driving-box shoe and wedge planing attachment, shell or crown-brass planing attachment, swivel-base vise, extension angle bracket and binders for machining the shoe and wedge fit on driving boxes, double chuck with bolts and binder for holding driving boxes, auxiliary adjustable back bearing, standard steel head, double head, large, intermediate and small rotary heads, 18 high-speed tools, special socket wrench for the

rotary heads, four open-end wrenches, three socket wrenches, a hex and flat socket wrench and two straight wrenches. The majority of these items are furnished by the manufacturers of the machine.

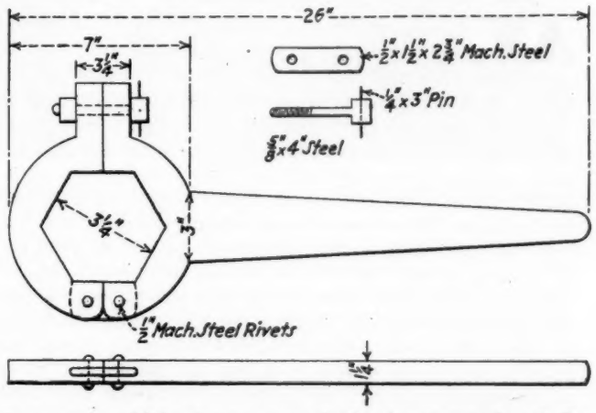

Piece No.1 2"x2"x⅜" L 1-Reqd. as shown
Piece No.2 1-Reqd. opposite hand
Piece No.3 2"x2"x⅜" L 16 Reqd.
Piece No.4 2"x2"x⅜" L 4-Reqd.
Piece No.5 2"x2"x⅜" L 1-Reqd. as shown
Piece No.6 1-Reqd. opposite hand
Piece No.7 2"x2"x⅜" L 1-Reqd. as shown
Piece No.8 1-Reqd. opposite hand
Piece No.9 2"x2"x⅜" L 1-Reqd. as shown
Piece No.10 1-Reqd. opposite hand
Piece No.11 2"x2"x⅜" L 8-Reqd.
Piece No.16 2"x2"x⅜" L
Piece No.17 1-Reqd.
Piece No.18 2"x2"x⅜" L 2-Reqd.
Piece No.19 2"x2"x⅜" L 1-Reqd. as shown
Piece No.20 1-Reqd. opposite hand
Piece No.21 2"x2"x⅜" L 2-Reqd.
Piece No.22 2½"x½" Strap 2-Reqd.
Piece No.23 2½"x½" Strap 2-Reqd.
Piece No.24 2½"x½" Strap 4-Reqd.
Piece No.25 2"x2"x⅜" L 2-Reqd.

Details of the rack

The rack affords a place to put these tools and fixtures in an orderly manner and also provides space for others that may be added from time to time. It is made of $\frac{3}{16}$-in. and ⅜-in. plates with riveted gusset plates for the shelving, welded at the corners, and shelf supports. All holes are punched or drilled $\frac{9}{16}$-in. for ½-in. rivets. All the joints are welded except where rivets are shown. The rack is made in sections which are bolted together with ½-in. machine bolts, 1½ in. long.

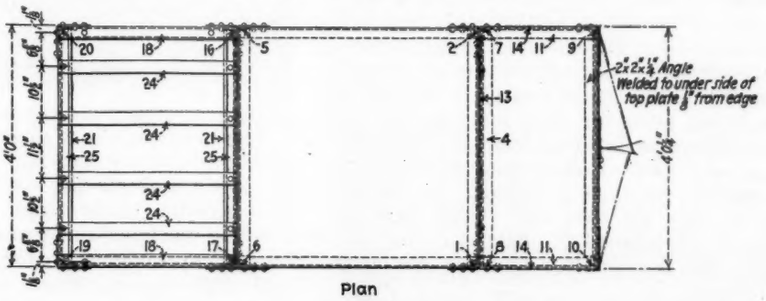
Wrench for Removing Ohio Boiler Checks

IN the drawing is shown a wrench which was designed to facilitate the removal of Ohio boiler checks. The method used prior to the adoption of the wrench was to apply a 36-in. Stillson wrench, which usually distorted the boiler-check body and ruined the hexagon points, rendering the check body unfit for further use. In attempting to use an open-end wrench, it invariably slipped and rounded off the hexagon points, making it necessary to resort to the Stillson wrench.

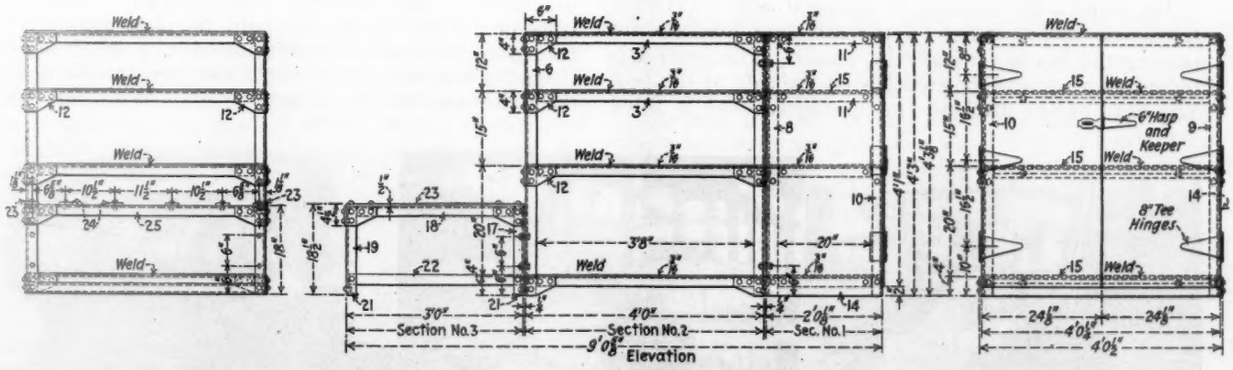


A wrench which clamps around the hexagon of a boiler check and removes it without distorting the check body

The wrench shown in the drawing, and now used effectively for removing the checks, opens up and clamps around the hexagon part of the boiler check. It starts the check out of the boiler without damaging it in any way. Since its adoption by the road on which it was designed, it has been found unnecessary to scrap any boiler checks which have become distorted on account of attempts to remove them from the boiler.



Plan



Rack for Morton draw-cut shaper attachments

NEW DEVICES

Production Milling In the Railroad Shop

AMONG the machines especially adapted to railroad shop milling work is the Hydromatic miller, of the Cincinnati Milling Machine Company, Cincinnati, Ohio, which is being used in a number of shops for cutting down production time on driving boxes, shoes and wedges, crosshead shoes and switch plates. The illustrations accompanying this article show some of the applications of this machine to the above classes of work and the fixtures that are used in setting up the different jobs. One railroad shop machines switch plates in quantities on a single-head Hydromatic which, because of the fact that the plates come through in a great variety of sizes and styles, is equipped with a special pneumatic fixture in which the work is slipped under two strap clamps and held by means of a double-acting air cylinder. Switch plates having two rail slots are milled at the rate of 14 pieces an hour.

For milling shoes, wedges and crosshead shoes an eastern railroad has a similar machine fitted with another type of pneumatic clamping fixture. Three milling cutters on this machine finish the inside and outside surfaces of the parts mentioned and for the wedges the fixture is arranged to mill the proper taper in the frame fit. The floor-to-floor time on the average wedge in this shop was reduced from 35 min. to 8 min. and the work is now handled with this single machine and one operator.

Another railroad is using a duplex Hydromatic miller on driving boxes. One of the illustrations shows the machine set up for milling the shoe and wedge fits on a driving box. The fixture is quite simple and is arranged for tilting so as to mill the tapers for the "rock" on the box. The machining time for each box of this type averages 90 min. Worn or repaired boxes are also handled on this type of duplex machine using a similar fixture that will handle two boxes at a time. In the case of repaired boxes only the shoe and wedge faces are milled as the inside surfaces of the flanges do not need to be refinished. The floor-to-floor time for this operation averages 17 min.

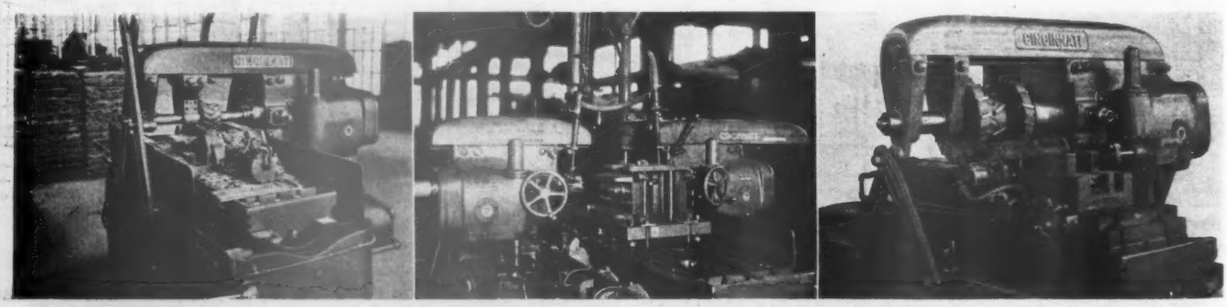
The duplex Hydromatic is equipped with individual torque motors mounted on the elevating brackets for moving the heads vertically by power. The control is by means of drum-type switches on the side of the bed. The head of the machine (or spindle carrier) is fitted with taper gibs with means for very sensitive adjustment so that the head may be clamped to the headstock by means of a cam lever below the overarm. A similar lever is used to clamp the quill, which also has a large handwheel for rapid and accurate hand adjustment. These are refinements in control designs to conserve the energy of the operator.

The 12-In. Fay Automatic Lathe

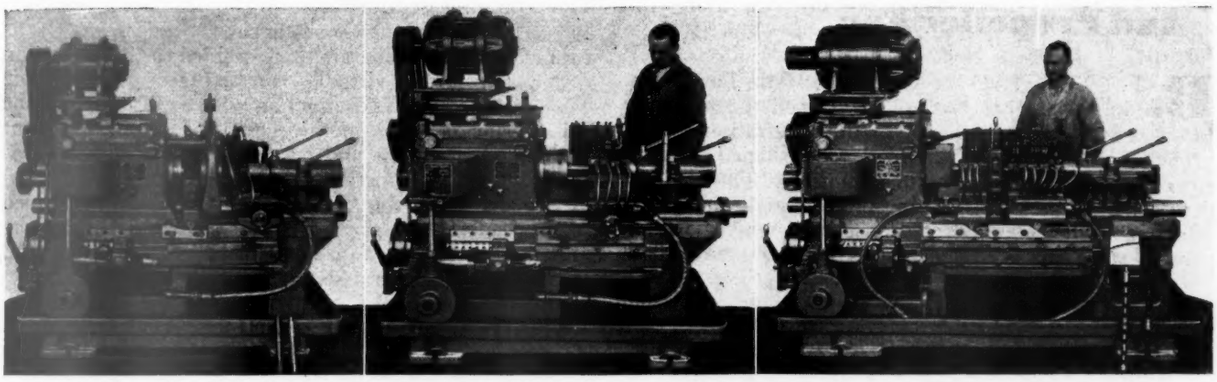
THE 12-in. Fay automatic lathe, manufactured by the Jones & Lamson Machine Company, Springfield, Vt., is a high-production machine that can be operated economically on continuous production or used for small lot manufacturing where several sizes and types of parts are required to make up a machine load. It can be set up in a short time for different work and, with its universal camming, standard tool blocks, wide range of speeds and feeds, and multiple tooling possibilities, makes a machine that will cover varied types of work supported between centers or held in a chuck or fixture. All tool movements are controlled by cams on the outside of the drum and the necessary movements have been incorporated in this machine to permit multiple tooling of any piece so that it may be machined using the shortest possible tool travel. It is built in four different lengths of bed: 15 in., 21 in., 33 in., and 45 in. between centers. It swings 13¼ in. over the center bar and 19½ in. over the carriage.

The bed is of box ribbed construction and is designed to give maximum strength and stiffness required for heavy work. The pan is cast integral with the bed and is provided with a large chip storage which is easily accessible for cleaning.

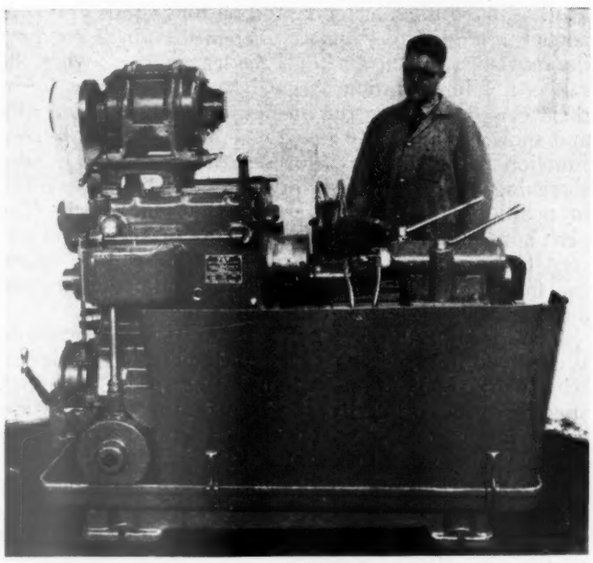
The headstock is a single pulley drive and equipped with anti-friction bearings throughout. The drive is through a multiple-disc clutch in the main drive pulley. The spindle, made from an alloy steel forging accurately machined and ground, is mounted on ball bearings set up under a predetermined pressure. All gears and shafts are hardened. The shafts are ground and mounted on ball bearings. The complete headstock runs in a bath of oil and both the fast motion and feed-gear mechanisms are lubricated by a splash system from the headstock. It has eight standard spindle speeds through four sets of change gears. With the main



Left: Cincinnati Hydromatic miller set up for milling switch plates held in a pneumatic fixture—Center: A Duplex Hydromatic set up to mill a driving box; the fixture is arranged to tilt to mill the "rock" on the box flanges—Right: Milling shoes and wedges



Left: The center drive attachment used on the 12-in. Fay automatic lathe—Center and right: Multiple tooling attachments



The 12-in. Fay automatic lathe

driving pulley running at 1,000 r.p.m., the following speeds can be obtained: 56, 72, 98, 130, 162, 215 290 and 377 r.p.m. A standard automatic speed-shift shaft can be installed so that two changes can be made automatically while the machine is under cut. Spindle speeds up to 1,500 r.p.m. can be obtained through semi-standard gearing.

The front carriage, or turning member, is supported at the center of the lathe by a heavy steel center bar supported in four renewable bearings in the headstock and tailstock. The outer end of the carriage is carried on a hardened and ground former which is mounted on a slide gibbed to the front of the bed. Both the center bar and the former slide are moved longitudinally by cams on the drum. By setting the hardened former parallel to the centers or on an angle, straight or taper work may be produced. This applies both for turning or boring. It is also possible to bore or turn any uneven profile or radius by installing a special hardened and ground former on the machine. The turning tools can also be arranged to relieve on the return stroke to avoid scoring the finished work.

The back arm or facing member is mounted on a large steel bar and is held in three adjustable bearings in the headstock or tailstock. The lower end of the back arm operates against the side cam or former on the rear former slide. The rear former slide may be drawn under the back arm by suitable camming. The back arm may also be moved longitudinally and, therefore, turn any straight, tapered or curved surface. The longitudinal movement may be combined with the facing travel so that a combination of turning and facing cuts may be taken if the piece being machined requires it. For facing bevel gears or similar parts an adjustable bevel attachment can be furnished. This bevel attachment has hardened guides which control the cut with this bevel attachment. Curved surfaces may be machined or any irregular shape by supplying special curved or irregular shaped guides.

The cam drum, with its adjustable outside cams, controls all movements. It has a fast motion through a multiple-disc clutch at the rear for idle movements and a slow motion or feed through change gears and a feed shaft at the front of the machine. The change in drum speeds from fast to slow motion and vice versa is controlled by adjustable cams and is entirely automatic. An adjustable knock-off disengages the main drive clutch and stops the machine at the end of one complete cycle of the machine. The main drum is located in a box-like recess in the bed directly beneath the headstock. The 12-inch by 21-inch, 12-inch by 33-inch, and 12-inch by 45-inch machines have two cam drums, one under the headstock and the other under tailstock. Should the occasion ever arise that more cam room be needed an auxiliary drum may be attached to either end of the machine.

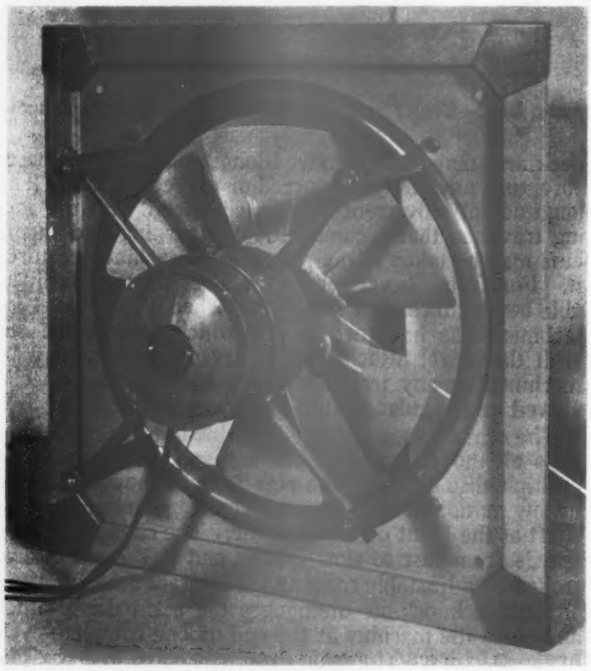
The machine has nine feeds through five sets of change gears. The drive is through change gears and a feed shaft. The carriage or turning feeds are .008, .011, .014, .019, .023, .027, .038, .048, and .062 inch per spindle revolution. The back arm, or facing feeds, are .008, .010, .019, .012, .017, .021, .024, .034, .043, and .056 inch per spindle revolution.

Dovetail tool blocks and slides are furnished with this machine to provide for a wide range of work. The dovetail tool blocks are made from heat-treated alloy steel and are reversible so that they may be placed on a dovetail slide with the tool slot toward the headstock or toward the tailstock as desired. All dovetail slides and tool blocks fit both carriage and back arm. One wrench fits all screws. A standard taper turner works in conjunction with these standard tool blocks so that straight and taper cuts may be taken simultaneously. Any curved or tapered surface may be machined with this turner which will reproduce and form developed in the operating template.

An auxiliary facing attachment or third cutting head may be attached to the machine. This is supported on a bar mounted through the tailstock and held in an outboard bearing in the headstock.

Sturtevant Speed Heater And Propeller Fan

B. F. STURTEVANT Company, Hyde Park, Boston, Mass., has recently developed the propeller fan and speed heater shown in the illustrations. The propeller fan consists of the blade, a U-shaped pressed-steel ring and a suitable motor mounting. The blade of the propeller fan has a varying pitch to make it equally effective at the base and at the tip while the U-section pressed-steel ring is designed to promote a smooth flow of air through the fan and to contribute to its efficiency. The mounting designed for the fan dampens vibration and offers minimum resistance to air flow. It is formed of steel tubing and bars welded to the U-section ring to make what virtually is a one-piece construction. The motors used in conjunction with the fan are of the ball-bearing type designed to operate 5,000 hrs. without lubrication attention and are suitable for either horizontal or vertical operation. They are totally enclosed to guard against dust and moisture and are equipped with speed regulators if desired. The panel mounting illustrated with the fan is furnished as an accessory. It is of welded pressed steel construction and can be securely fastened to the fan.



The Sturtevant propeller fan

The Sturtevant speed heater

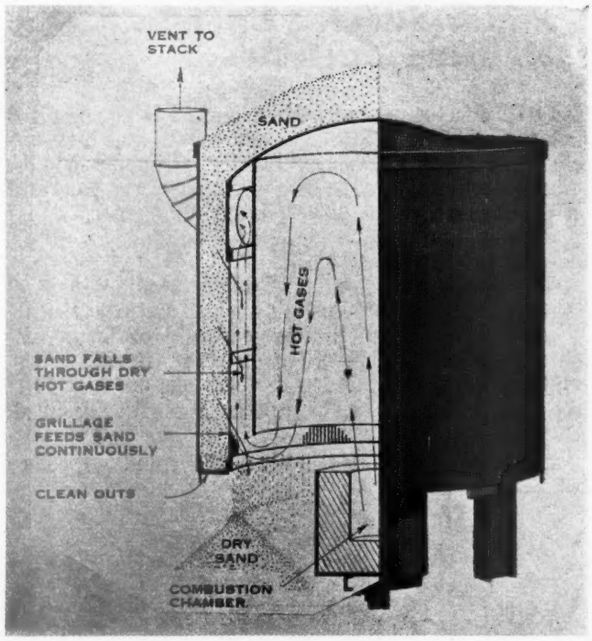
The fan is made in 12-in., 16-in., 20-in. and 25-in. sizes and can be furnished with automatic shutters or safety guards, or it can be used in connection with a pent house when it is desired to install the fan on a roof. The automatic shutters consist of light aluminum leaves, linked together, mounted on hinge rods and supported in angle-iron frames. When the fan is running, the movement of the air holds the leaves open; when the fan is not in operation the weight of the leaves keeps them closed, blocking the opening and shutting out rain and snow. The safety guard which can be used in conjunction with the fan consists of ½-in. mesh wire screening, welded to wire rings and cross braces. When in position it completely covers the fan wheel. The pent house used with the fan is made of sheet steel riveted to an angle-iron framework. The shutter leaves are similar to those used on the automatic shutters and automatically close when the fan is not in use.

The speed heater shown in another of the illustrations is designed for use in shops, enginehouses and small outlying work shops. It has two operating speeds. The high speed is used primarily for fast heating and the low speed for maintaining a normal set temperature. It is designed for use with steam pressures up to 250 lb. but the heating elements are designed to work as efficiently with low- as with high-pressure steam. No alterations or special provisions are necessary to operate the heater on different steam pressures.

The heaters are equipped with louvres, their purpose being to break up the air flow and spread it over a wide area. The heater may be equipped with thermostatic control of various types, one type shutting off the steam, while another shuts off the fan, leaving the steam in the heater. The use of the various thermostatic-control devices depends on conditions surrounding the installation of the heater and can be furnished to specifications for particular installations. The heaters are made in six sizes weighing 65 lb., 70 lb., 125 lb., 150 lb., 180 lb. and 410 lb. respectively, and are equipped with standard-voltage motors.

Reverse-Draft Sand Stove

THE Johnson Manufacturing Company, Minneapolis, Minn., has recently placed on the market the reverse-draft sand-drying stove shown in the illustration. The stove is equipped with a vacuum-type oil burner, the hot gases from which are reversed twice before escaping through a vent to the stack. The continued application of the hot gases provides uniformly dry sand free from ash and coal dust. The dry sand falls through the dry hot gases, the grillage, which forms one wall of the vent for hot gases, feeding sand continuously as it becomes dry. The direction of the gases and the manner in which the sand feeds through the grilled walls of the



The Johnson reverse-draft stove for drying sand

sand chamber is shown graphically in the illustration.

The stove is 5 ft. high, 4 ft. 2 in. in diameter and has a hopper capacity of .85 cu. yd. (2,750 lb.). It has a sand capacity of .5 cu. yd. per hr. (1,620 lb. per hr.) and a fuel consumption of 1.6 gal. per hr, which is the equivalent of 1 gal. per 1,000 lb. of sand or 1 gal. per 3.2 cu. yd.

Rooksby Portable Cylinder Boring Bar

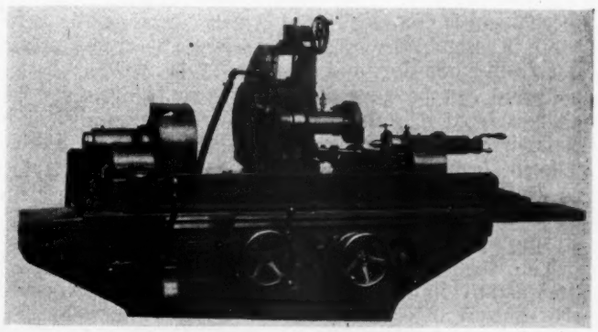
E. J. ROOKSBY & CO., 1042 Ridge avenue, Philadelphia, Pa., has incorporated several improvements in its unit quick-centering valve-chamber boring bar which are of particular advantage for valve-chamber boring where a high degree of accuracy and a high quality of workmanship are essential. This machine is also equipped with Rooksby unit quick-centering crossheads for use when the railroad has a number of locomotives having the same size bushings to be rebored. This feature saves time in setting up the bar, as the crossheads fit in the end of the valve chamber and are self-centering.

A description of the motor-driven Rooksby portable cylinder and valve-chamber boring bar appeared in the June, 1925, issue of the *Railway Mechanical Engineer*, page 386. Previous to the improvements referred to in preceding paragraphs, the gear drive for all Rooksby boring bars was made in sizes below six inches with spur gears. The new gear drive has helical gears which reduce maintenance and also insure accurate work free from chatter marks. The drive is entirely enclosed with guards, cast integrally with the frame, which tend to strengthen the body of the machine.

The unit quick-centering crossheads are extra heavy with the arms designed wide at the center and tapering to the ends. The tool holder can be used with high-speed steel or Stellite cutters, thus eliminating forged tools. The valve-bar cutter heads have a tool holder built in, thus enabling the shop to use the same size gears as are used in the tool holders of the cylinder bars.

Cincinnati Universal Cylindrical Grinder

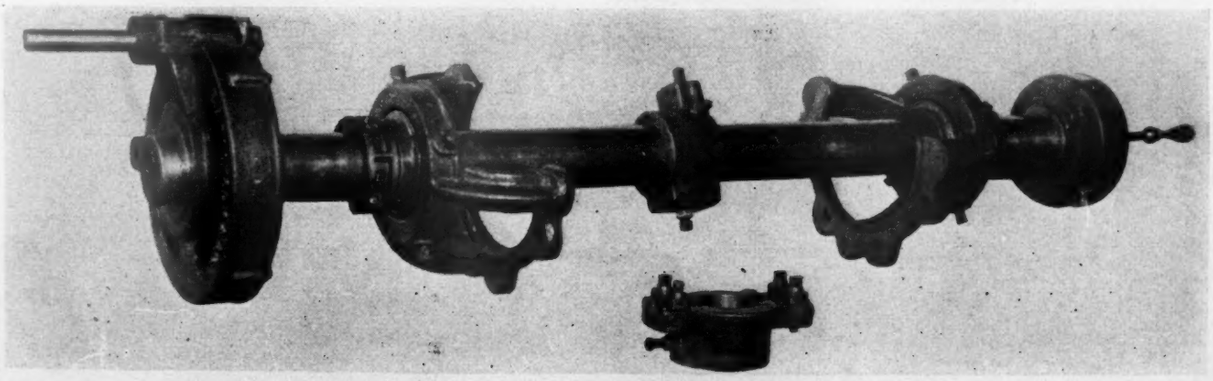
A SPECIAL adaptation of the Universal cylindrical grinder was recently supplied to a large railroad by Cincinnati Grinders, Inc., Cincinnati, Ohio, which permitted the machine to be used both for straight cylindrical grinding and for cutter grinding. The machine, a Cincinnati 16-in. by 48-in. Universal grinder,



The Cincinnati 16-in. by 48-in. cylindrical grinder

was standard throughout with the exception of the grinding-wheel head. The standard head was replaced by a head carrying a vertical slide adjustment and spindle with a wheel at each end.

As shown in the illustration, a straight-sided wheel for cylindrical work is mounted on the left end of the spindle, and a cupped wheel for cutter grinding is



Rooksby unit quick-centering valve boring bar

mounted on the opposite end. This head is carried on a swivel base which makes it easy to move the wheel quickly into position. For a wide range of universal work in railroad shops the straight-sided wheel is used and for heavy cutter grinding the base is swivelled and the cupped wheel employed. A small hand wheel located on the top of the fixture operates the vertical spindle adjustment. A screw moves the slide which rides on a scraped dovetail and is secured by a tapered gib. By adapting this standard machine to large cutter and reamer grinding the usefulness of the machine in the railroad shop is increased.

Bastian-Blessing Cutting And Welding Equipment

THE CC cutting torch, shown in the illustration, is a product manufactured by the Bastian-Blessing Company, 240 East Ontario street, Chicago. The object of the design is to provide a light-weight, heavy-duty tool made from strong materials to permit a reduction in the size and weight of the various parts without sacrifice of strength or capacity. All parts are made of bronze forgings, bar stock or tubing, with the exception of the head, which is of drop-forged monel metal.

Both preheat control valves and the high-pressure oxygen control valve are located in the base valve and are accessible for servicing from the outside. No mechanism is contained inside of the torch handle. The torch is assembled with a 90-deg. angle head as standard, but 75-deg., 35-deg. and straight heads are interchangeable and can be furnished separately if desired. The change from one angle to another is accomplished by removing the two lock nuts at the end of the head tubes. The torch may be had with tips for use with acetylene as well as other types of fuel, such as butane, propane, by-products, coke gas and natural gas, with capacity for cutting up to 18 in.

The Rego economizer is a gas shut-off device that is designed to eliminate leakage. It has no packing or seat, the shut-off valves being of the diaphragm type. The diaphragm of the valve acts as the seat, this construction being adopted because of the little likelihood of leakage. The Rego economizer is obtainable for both high- and low-pressure gas systems.

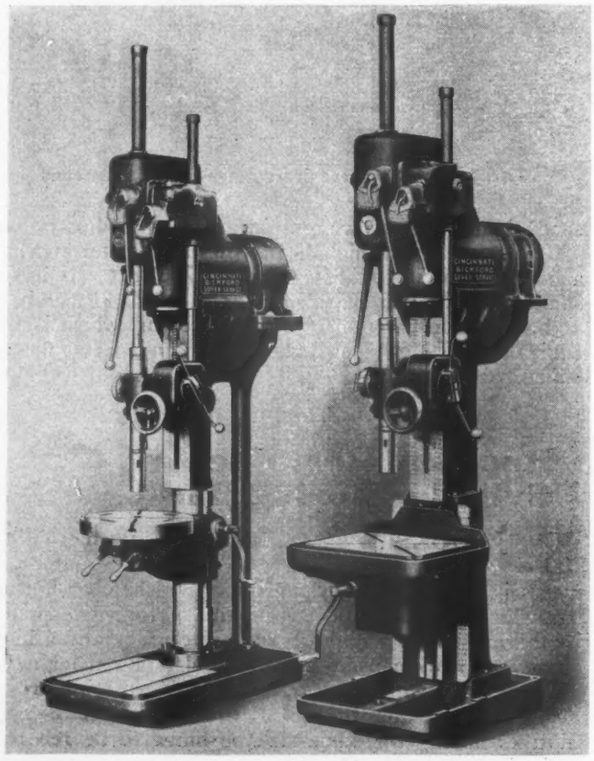
The Red Star regulator is designed to supply a constant delivery pressure at any desired point from one to thirty pounds. It delivers gas to welding and cutting torches simultaneously and is designed to assure a constant neutral flame regardless of the pressure of the tank.

Super-Service Upright Drilling Machines

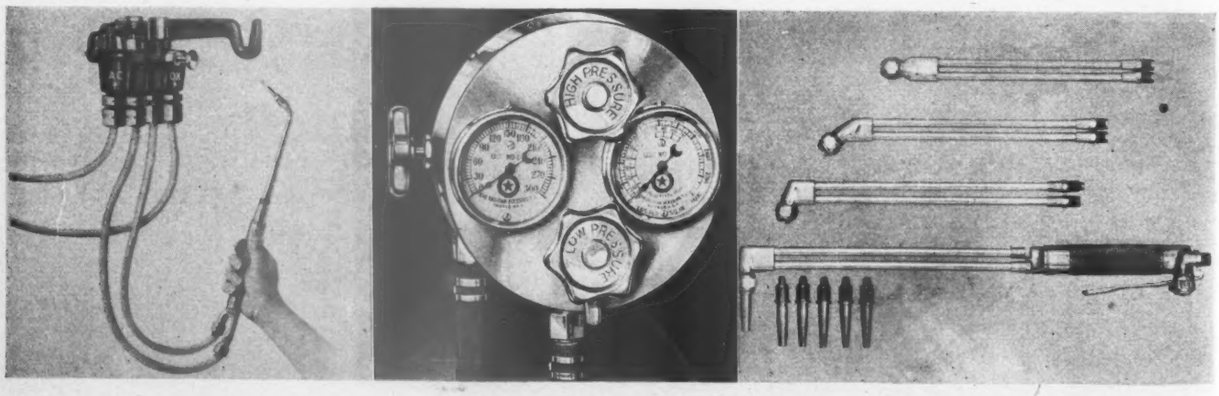
THE development of a 21-in. and 24-in. upright drilling machine has been completed by the Cincinnati Bickford Tool Company, Oakley, Cincinnati, Ohio. These machines, to be known as Super-Service uprights, are built in either round- or box-column construction, as illustrated, and may be equipped either for general purpose or single purpose work.

The standard machine has twelve spindle speeds, obtained through selective sliding gears and controlled by a single lever. The sliding gears are of heat-treated chrome-nickel steel mounted on shafts having integral multiple keys. Ball and roller-bearings are included in the design and all mechanism is automatically flooded with oil.

Direct-reading plates indicate the spindle speeds at



The Cincinnati Bickford Super-Service upright drilling machines of round- and box-column construction



Left: The Bastian-Blessing Rego economizer—Center: The Red Star regulator—Right: The CC cutting torch

which the machine operates and also indicate nine rates of feed which are controlled by a single lever. The feed changes are obtained through selective heat-treated alloy steel sliding gears with broached integral keys. The sliding head is counterbalanced and is fully enclosed. The feed is engaged by either of two pilot levers which control the advance and return of the spindle. A sidewise movement of either of these levers engages a positive-type feed clutch which controls a constant-mesh worm-type feed engagement running in oil. An adjustable feed trip may be set to disengage the feed at the required depth, while safety trips automatically disengage the feed at the top and bottom limits of travel.

The 3-hp. or 5-hp. motor with which the machine can be equipped is directly connected and its closely coupled mounting locates it out of the operator's way and in a position where chips and dirt cannot cause damage. The driving clutches are built along the Cincinnati Bickford unit principle of design by being completely assembled in a self-contained drum housing. They are mounted on large ball bearings and are automatically flooded with oil. The forward and reversing clutches are actuated through internal expanding rings of heat-treated bronze, fitted into hardened steel cups which are integral with the driving bevel gears. The driving clutches operate at constant speed to insure constant maximum power at all spindle speeds.

On the round-column machine the table arm, as well as the table, is clamped from the front. The Super-Service uprights are to be had as single units, or combined into drills of either the high base or low base type.

Covel-Hanchett GK Grinder

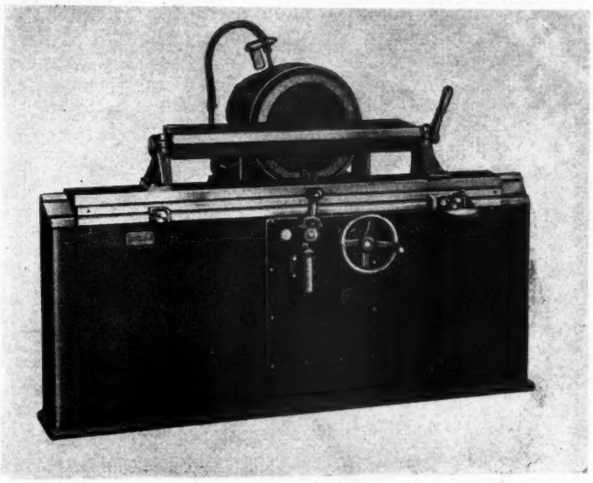
IN the illustration is shown the Covel-Hanchett GK grinder, a product of the Covel-Hanchett Company, Big Rapids, Mich. The grinder is equipped with a cabinet base, ball-bearing arbor, a Hanchett Red Anchor cylinder grinding wheel and water attachments, and is designed for full automatic operation. These machines, in the smaller sizes, cover a range of service largely employed in car shops, pattern shops, planing mills, etc. In the larger sizes they are for grinding veneer and paper knives, shear blades, and other comparatively long unit grinding service.

Standard equipment includes a 12-in., 14-in., or 16-in. grinding wheel (according to the capacity of the machine) of the Hanchett Red Anchor cylinder-wheel type which is designed to save approximately 40 per cent in grinding-wheel expense over the ordinary cup grinding wheel. A segmental wheel in an all-steel chuck can be supplied when desired in place of the Red Anchor cylinder wheel.

The knife bar is installed as a solid unit integral with the carriage, with no slide adjustments or adjustable connections. Instead of feeding the knife bar, slides, supports and work to the grinding wheel, the grinding wheel is fed to the work. The grinding head is mounted on a broad, heavy slide, making a rigid mounting and facilitating the control of the feeding and grinding operations.

The grinding-wheel spindle is equipped with New Departure ball bearings. All other bearings with running shafts are of bronze. The transmission of the clutch gear type is installed and is removable as one complete built-in unit, enabling ready access for replacements or repairs. Cross-feed of the grinding wheel can be operated both by hand and automatically.

The grinder is furnished with a knife bar having heavy cored sections with T-slots, or a combination bar with T-slots and separate clamps for thick and thin knives. An indicator, furnished for grinding at any bevel, is adjustable for grinding towards or away from the knife edge.



The Covel-Hanchett GK Grinder the grinding wheel of which is fed to and away from the work

A large tank in the base of the machine with a built-in centrifugal pump supplies water or cooling compound at the grinding wheel. The machine is compact, with all units built into the machine base to combine low cost and minimum space.

All-Welded Rolled-Steel Gear Blank

LUKENWELD, Inc. (division of Lukens Steel Company), Coatesville, Pa., which is primarily engaged in the design and manufacture of welded steel assemblies for machinery and equipment, has developed and is now manufacturing all-welded rolled-steel gear blanks for use in the manufacture of cut gears. This gear blank is the culmination of a considerable period of research and experimental work, and patents on the blank have been applied for.

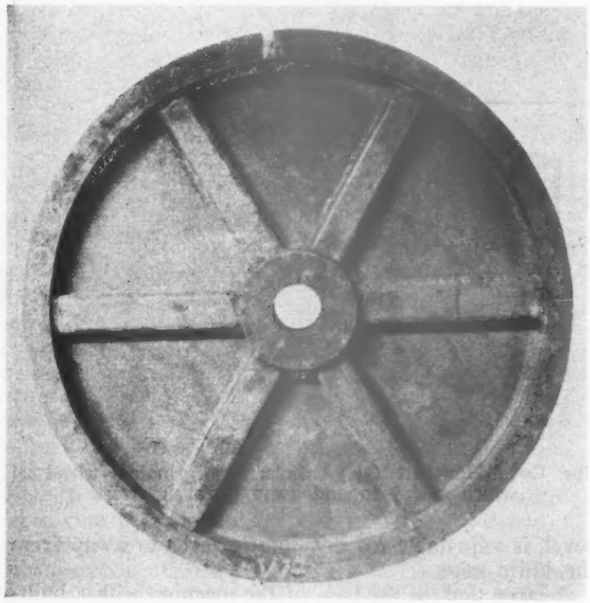
The welded steel blank, which can be employed in the manufacture of spur, herringbone and helical gears, can be made any size from 24 in. outside diameter up. The largest all-welded gear blank made up to the present time is one with a shipping weight of 4,350 lb. It is of 66¾-in. outside diameter, 11¾-in. face width, 4⅛-in. thickness, and 22½ in. hub diameter.

While the all-welded gear blanks are ordinarily made entirely from S. A. E. 1020 carbon steel, the rims can be furnished in steels of special analyses if desired.

The hubs of the all-welded gear blanks are first cut by gas from solid rolled steel of the thickness to give the desired hub diameters. The webs are gas cut from rolled-steel plate, as are the ribs, the latter being formed into channels of the required section. The webs are arc welded to the hubs, and the reinforcing channels are welded to the web structures. The final operation consists of the circular bending of the gear ring and arc welding it in position to form the finished gear blank.

Before shipment all of the welded gear blanks are carefully and thoroughly annealed under pyrometric furnace control. Welding operations are under rigid procedure control and in accordance with insurance welding practice.

Since no time is required for pattern making, this construction has an important advantage in filling requirements occasioned by gear breakdowns. The major advantages of the all-welded gear blank, however, are the purity and homogeneity of the thoroughly annealed rolled steel from which the gear blanks are made. Rolled steel is free from blowholes, gas pockets, hard or spongy spots and other defects, and gear rings made of it can be uniformly cut, with teeth that will be sound in structure.



The Lukenweld all-welded rolled-steel gear blank

Horizontal Boring Drilling And Milling Machines

TWO spindles,—the conventional main spindle and an auxiliary high-speed spindle—comprise one of the features of the No. 70 horizontal boring, drilling and milling machine recently developed by the Giddings & Lewis Machine Tool Company, Fond du Lac, Wis. The main spindle, 7 in. in diameter, gives 36 speeds in geometrical progression within the customary range for a machine of its size. The auxiliary high-speed spindle, 4 in. in diameter and mounted within the back-gear shaft of the main spindle, gives an additional 36 speeds or a range of four times that of the main spindle. These two spindles give a combined speed range of from 3 to 720 r.p.m.

All the speeds and feeds for the spindles are built within an enclosed head. The 36 changes of speed of either spindle are controlled through two levers, each speed-change lever having a position indicator that facilitates the selection of the desired speed.

The 18 feeds of either spindle are obtainable through a feed unit built on one of the front cover plates of the head. The removal of this plate removes the complete feed unit for inspection. A rotary gear-change lever controls nine feed changes and indicates on a dial the feed applying at any time. A back-gear lever connects the rotary gear-change lever with another nine feeds. A set of pick-off gears is incorporated in the feed-gear train so that by different gears any desired lead may be obtained. A hand wheel is provided at the upper left of the head for a slow hand feed to either spindle. The feed is applied to the spindles by rack and pinion. The racks have a loose tooth at each end as a safety limit to the travel of the spindles in either direction.

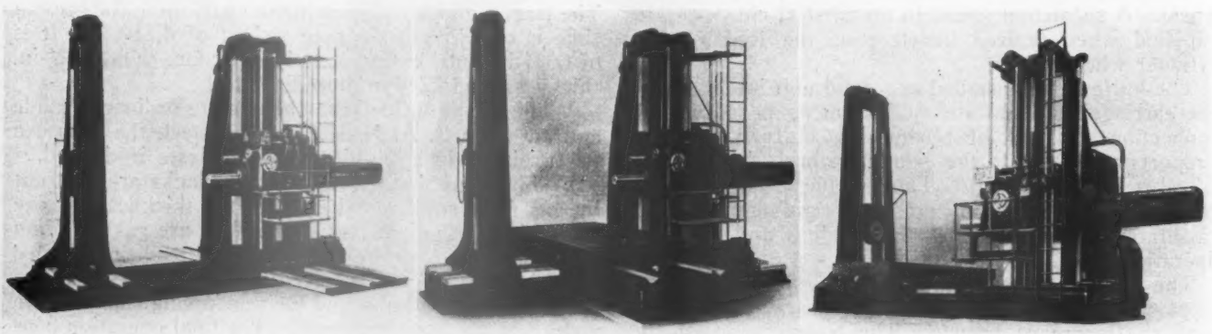
Incorporated in the feed train is an automatic depth gage which is applicable to either spindle. It can be set to automatically throw out the feed at any point within a 3-in. travel on the main spindle and within a 6-in. travel on the high-speed auxiliary spindle.

A spindle selector lever controls the operation of the spindles. When the speed and feed mechanism is connected to the high-speed spindle the spindle selector lever keeps the main spindle from coasting. A separate clamp is provided for locking either spindle in any position for milling.

The entire head is automatically lubricated. A pump delivers oil to a distributor at the top of the head from which oil is directed over the inside of the head, lubricating all running parts. A platform is attached to the head and travel with it for the convenience of the operator.

The column for the head weighs approximately 18,000 lb. On the inside it is ribbed in both directions to offer a stiff support for heavy milling at the extreme travel of the head. A counterweight for counterbalancing the head is within the column.

The column sets on a large base which contains the main driving clutches for starting, stopping and reversing the machine. Within this column base there is also a complete milling-feed unit for 18 feeds and rapid tra-



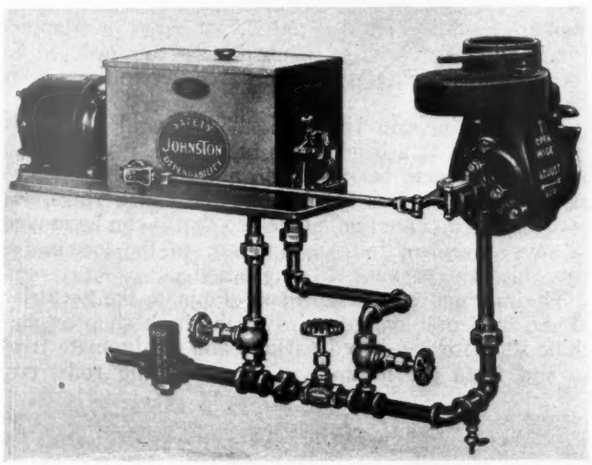
Left: The Giddings & Lewis floor-type horizontal boring, drilling and milling machine—Center: The planer-type machine —Right: The table-type machine

verse for moving all the different units of the machine. In this way it is possible to obtain a range of feeds in inches per minute that are suited to milling, and independent of the boring and drilling feeds for the spindles. The changing of feeds is accomplished through a back gear lever and a rotary gear change lever mounted on the head of the machine close to the spindle feed-change levers.

The illustrations show the table type, planer type and floor type machines in which the No. 70 machine is obtainable. For all three types the same head, column, column base, mechanism and end support are used. On the table-type and planer-type machines a box table is used with a large number of reamed stop holes in the top and tee slots that run the full length of the table. On the table- and planer-types the end support block moves in unison with the head. On the planer-type the head, column and column-base mechanism are movable along a runway at right angles to the travel of the table. The table type machine can be equipped with tables up to 72 in. by 144 in.

Automatic Controllers For Oil Burners

AN automatic controller for oil burners designed with a piston oil feed has recently been placed on the market by the Johnston Manufacturing Company, Min-



The Johnson automatic controller for oil-burner equipment

neapolis, Minn. The controller is designed to be unaffected by sediment or other solid or semi-solid matter or water in the oil. In order to deliver the proper quantity of oil continuously regardless of the quality of the oil, and to eliminate clogging by dirt in the line, the controller is constructed with no valve adjustment in the oil line.

The controller consists of a power-driven oil metering pump driven by a directly connected constant-speed motor, in connection with an adjustable crank for connection to the air-controlling mechanism of the burner. The controller operates in connection with any standard control pyrometer or control thermometer. It operates on the high-low principle and is not intended to operate on-off burners.

In operation, the driving motor and metering pump run continuously, no other parts operating except when cycling. The oil is metered to the burner and adjusted by levers and screws located at one end of the unit. All the oil delivered to the burner passes through the metering pump and is metered to the burner regardless of its temperature, viscosity or pressure as long as these remain constant within the usual limits. The controller is fitted with a Johnston V-notch oil valve in a by-pass to the burner to provide a means for manual operation for special purposes when manual operation is more convenient than automatic. The air connection may be disconnected at the burner and the air adjusted by hand at the same time.

The controller is made in two sizes, B-7 and B-9, which have capacities of 20 gal. and 30 gal. per hr. respectively. The net weight of the controller is 78 lb.

Crawler-Mounted Loadmaster Crane

IN the illustration is shown a Loadmaster crane equipped with a Model GH Trackson crawler. This crane, made by Bucyrus-Erie Company, South Milwaukee, Wis., provides a means for lifting, carrying and spotting heavy or unwieldy objects such as car parts, rails, freight, etc., in railway shops, yards and warehouses.

The mobility of the Loadmaster equipped with Trackson crawlers permits its use wherever the crane is needed, inside the shops or in the yards. It is equipped with ground-gripping crawlers to provide sure footing and positive traction in soft, loose sand, slippery mud or clay, cinders, sawdust, wet snow, etc. The unit is compact and can be operated in very close quarters since it has a fully revolving boom and is designed to turn in a short radius. It is 9½ ft. in overall height to permit it to travel through doorways.

A feature of the crane is the fully revolving boom which permits the operator to spot and pick up the load quickly and to place it accurately. The boom is power driven and is equipped with a brake so that it may be set at any angle desired over the front or sides of the tractor. The speed of the boom's swing is controlled by the operator.

With the standard 14-ft. boom the Loadmaster has a maximum lifting height of 16 ft. 6 in. under the hook. With the boom lowered, it has a maximum outreach of 14 ft. from the center of the mast in any direction. Where unusual conditions require a higher lift

The Bucyrus-Erie Loadmaster fully revolving crane equipped with a model GH Trackson crawler and McCormick-Deering power unit

or greater outreach, special booms can be furnished.

The crane may be used for hauling purposes as well as for lifting. The Trackson crawler used on the Loadmaster crane is manufactured by the Trackson Company, 1320 South First street, Milwaukee, Wis. The Loadmaster is also available with wheel mounting.

Niles No. 6 End-Drive Lathe

THE Niles No. 6 end-drive lathe recently placed on the market by the Niles Tool Works Company, Hamilton, Ohio, is a high-production machine suitable for turning axles, forgings, piston rods, crank pins, brake-beam ends, etc., and is designed to permit precision work as well as rough turning. The headstock, mounted on the bed at the left-hand end of the machine, is fully enclosed. The main gear and pinion, of steel and of the herringbone type, are lubricated by running in an oil bath. End thrust is taken up by a series of bronze liners, one rotating in an oil-filled trough below it, providing continuous lubrication. A face plate of any design to meet specifications can be furnished.

The feed box is a fully enclosed unit mounted on the front face of the bed adjacent to the headstock. The feeds are driven through sliding steel gears and are changed by long vertical feed-change levers located in front of the feed box for ease of operation. The feed shaft is provided with a ball end-thrust washer lubricated by a centralized oiling system which furnishes lubrication for all gear faces and bearings.

The carriages, which can be arranged to suit requirements, have longitudinal feed through half nuts engaging the lead screw, while hand longitudinal traverse and hand cross feed to the tool is also provided. The lead-screws half nuts are disengaged through a spring-actuated hand knockout. The carriages have a large bearing area on the bed and are fitted with taper gibs at both the front and rear bed way, and a clamping bolt for locking them in a fixed position. Wipers with felt pads are attached to wing ends for removing all chips and dirt from bed ways and to provide a continuous supply of lubricant. The aprons are of double-walled construction, enclosing all operating mechanism and eliminating overhung shafts.

The tailstock, which can be arranged with either a live or dead center, is made up of two sections, the top one having a slight cross adjustment for taper turning. It is traversed by rack and pinion by means of a hand lever. The spindle is moved in and out by means of a hand wheel and is locked in position by a clamp which does not affect its alinement. A coolant system is provided, circulated through a motor-driven rotary pump unit which is attached to the rear of the machine. The bed of the machine is a rugged casting. All the gears of the machine have the Maag tooth form and are lubricated by the centralized oiling system which furnishes lubricant, where possible, to all moving parts.

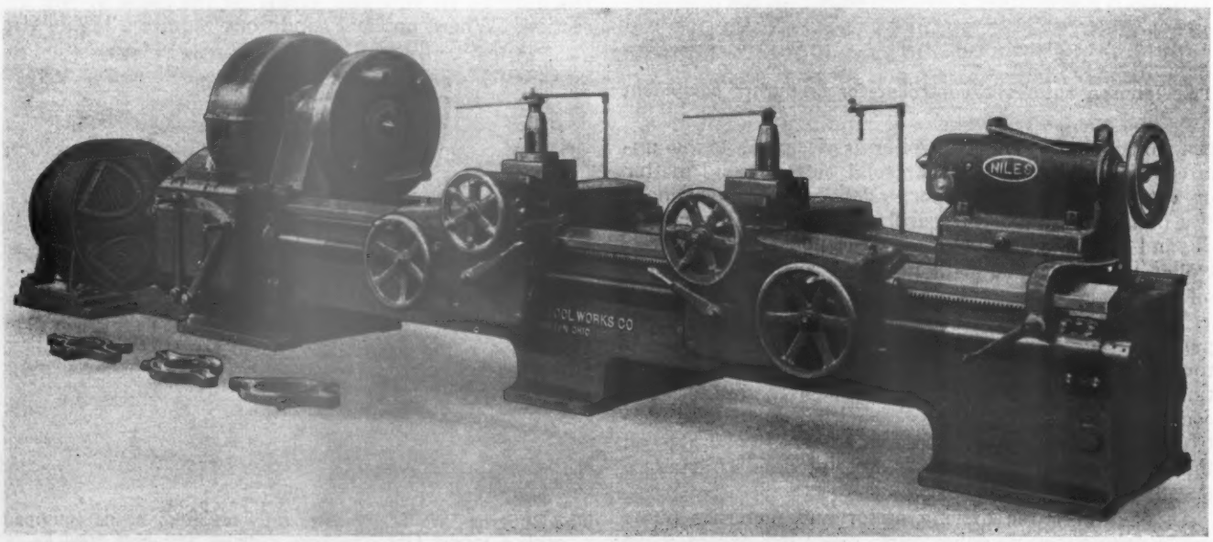
Piston-Rod and Valve-Stem Packing Boring Machine

THE Whiting Corporation, Harvey, Ill., has recently brought out a pneumatically operated boring machine for machining piston-rod and valve-stem packing. The cutting tool revolves at 300 r.p.m. and feeds downward .006 in. per revolution and, when through the bore, the feed cuts off automatically. To elevate the spindle to starting position a knob at the side of the machine is raised which permits the spindle to come up automatically at the controlled rate of ¼ in. per revolution.

A ball-bearing, rotary air motor is built into the base of the machine. The boring spindle and its bearings are hardened and ground. Chuck rings or adapters for holding the packing while boring are ordered to specifications submitted by the purchaser to fit various sizes of packing.

The machine can be installed in several ways. It can be bolted to a bench, to a bracket on a wall or on a post, or it may be placed on a pedestal base which also includes shelves for holding the chuck rings. It may also be mounted on a truck so that it can be moved to any convenient location adjacent to the locomotive for which the packing is being bored.

The machine was designed to eliminate the necessity of the mechanic making trips to the back shop or machine shop for the bored packing and to eliminate trips to and from the locomotive for calipering rods, etc.



The Niles No. 6 end-drive lathe for turning axles, forgings, piston rods, crank pins, etc.

It is adapted to enginehouse use for completing packing accurately and quickly.

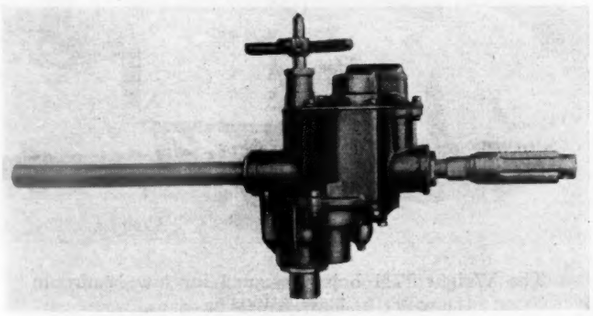
Tests conducted with the machine have shown that packing can be bored completely in two minutes. The machine weighs 100 lb. but with a pedestal attached the total weight is 175 lb. The machine is particularly useful in a large enginehouse where all

The Whiting locomotive piston-rod and valve-stem packing boring machine

the time of one man is devoted to renewing piston-rod, valve-stem, boiler-feed pump and air-pump packing. The machine can also be used at small outlying points for boring packing where a lathe is not a part of the enginehouse equipment.

Chicago Pneumatic No. 99-C Rotary Drill

THE No. 99-C pneumatic rotary drill recently developed by the Chicago Pneumatic Tool Company, 6 East Forty-fourth street, New York City, is designed



The CP No. 99-C pneumatic rotary drill

for general-purpose drilling and reaming, especially in close quarters. It is a power-vane tool employing no pistons, toggles or crank shaft and is equipped with a replaceable hardened-steel cylinder liner, ball or roller bearings throughout, as desired, and is of through-bolt construction to facilitate repairs. It is furnished with a governor control on the intake air supply to maintain free speed and to reduce air consumption on the power side and back pressure on the exhaust side. Governor-controlled light speed prevents wear and breakage of taps, drills and reamer bits. The drill is equipped with an adjustable exhaust deflector and muffler and is of the offset motor design with inside M.T. socket, feed screw and extractor pin, with a grease seal to prevent grease from entering the spindle socket. Complete lubrication for the motor is effected by a line oiler located in the housing. The drill is also furnished with adjustable fittings on the gear and governor cases.

The drill is regularly furnished with a standard type throttle but a throttle of the safety type can be furnished if specified. The drill weighs 35 lb., and operates at a light speed of 300 r.p.m. The length of feed is 4½ in. and it has drilling capacity of 1½ in. and a reaming capacity of 1⅛ in.

American 30-in. Super-Productive Lathe

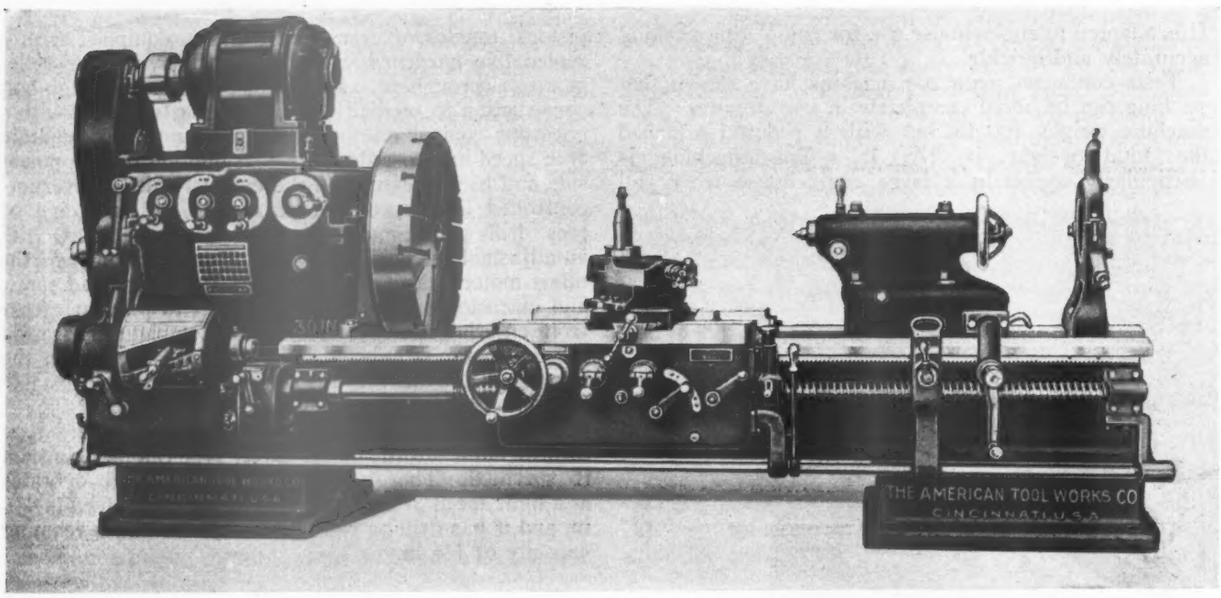
IN the illustration is shown a 30-in. American lathe which is equipped with a 16-speed triple-geared head with face-plate drive. The lathe, a recent product of the American Tool Works Company, Cincinnati, Ohio, is of the geared selective-speed type and can be either belt or motor driven. The design provides 8 of the 16 spindle speeds through internal-gear face-plate drive. The remaining eight spindle speeds are transmitted through the spindle gear. The highest internal gear speed available is 29.3 r.p.m. which provides approximately a 46 ft. cutting speed on work 6 in. in diameter. The 16 spindle speeds are obtained through 18 gears, including the face plate, internal gear and pinion, without the use of either friction or jaw clutches. All speed changes are made through slip gears, the only ones in operation at any time being those that are transmitting power. By removing several of the driving units of the head, it can be simplified for use with an adjustable-speed motor, eight mechanical speeds being provided after the simplification.

The motor is mounted on the headstock and connected to the initial driving shaft by herringbone gears. The gears are fully enclosed and are continuously flooded with oil. The motor pinion is mounted on S K F ball bearings and is totally enclosed for the exclusion of dust and dirt.

The lathe is equipped with an automatic oiling system, the oil being pumped by a gear-driven Brown & Sharpe oil pump from a reservoir at the bottom of the head to a distributing chamber in the top cover. Before the oil reaches the bearings it passes through a filtering pad in the distributing chamber. It then drips into smaller reservoirs, from which it is fed through tubes to the various bearings.

The lathe is equipped with a hardened-steel multiple-disc starting clutch and brake which are incorporated in a detachable unit located in the driving pulley of the belt-driven lathes or in the large gear of motor-driven lathes. A mechanical apron control for operating the starting clutch and brake is operated by a lever at the right-hand side of the apron.

The bed lathe is of the American drop V type and is



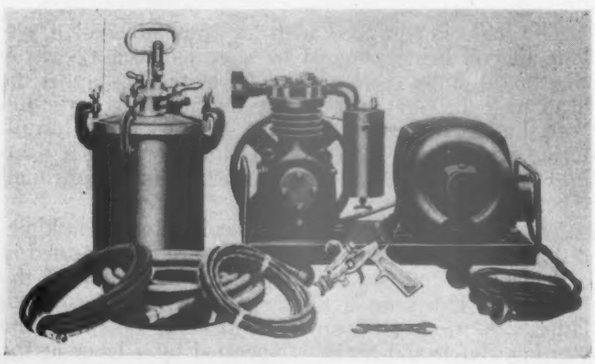
The American 30-in. lathe equipped with a 16-speed triple-geared head with face-plate drive

ribbed transversely with double-wall cross girths spaced 2 ft. apart. A rib is carried lengthwise in the center of the bed which has a rack cast integral with it. The tailstock is provided with a pawl which engages this rack for resisting the end thrust when heavy work is being turned. The tailstock is of the four-bolt design, the spindle being clamped in position by means of a double-plug binder.

Renewable bushings are fitted in all cylindrical members subject to wear. The spindle bearings are made in halfs with laminations between the cap and the head to permit taking up wear. The leadscrew, made of high carbon steel, is 2¼ in. in dia., one thread per inch.

DeVilbiss Complete Spray-Painting Outfit

A COMPLETE spray-painting outfit, especially designed to be operated by one man, has recently been placed on the market by the DeVilbiss Company, Toledo, Ohio. This outfit, known as the DeVilbiss NK-606, is electrically operated, is of light construction, and is designed to handle extensive maintenance work in stores, office buildings, railroad shops, etc., including the finishing of interiors, furniture and equipment, etc.

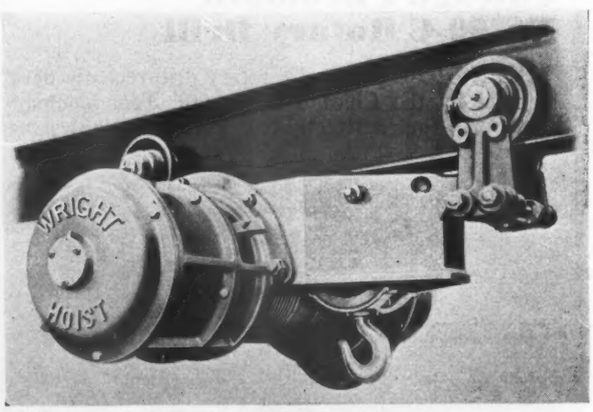


The DeVilbiss NK-606 spray-painting outfit

The NK-606 outfit consists of a motor-driven compressing unit powered by a ½-hp. motor, mounted on a castor base, one pressure-feed spray gun, one 2-gal, pressure-feed paint tank, one 20-ft. length of $\frac{5}{16}$-in. air hose and connections, one 12-ft. length of ¼-in. braid-covered hose and connections, and one 12 ft. length of $\frac{5}{16}$-in. fluid hose and connections.

Wright WH Hoist For Low Headroom

THE Wright type WH electric hoist produced by the Wright Manufacturing Company, Bridgeport, Conn., is designed for low headroom installations. The minimum distance from the bottom of the I-beam to the hook of the one-half ton hoist is 11 in. and on the one-ton



The Wright WH hoist designed for low headroom installations

hoist, 13 in. The hoist is equipped with push-button or pendant-rope control, Tru-Lay cable, a safety-type limit switch, a safety-type load block, mechanical brake and

is also fitted with heat-treated forged gears and pinions.

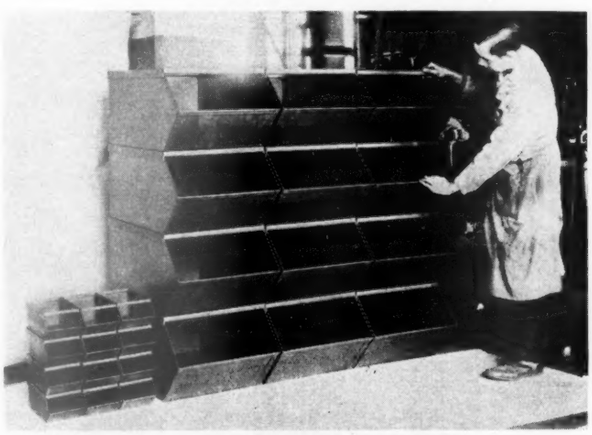
The drums of the hoist are full size and are not reduced to obtain the short distance from the bottom of the I-beam to the hook. They are 30 times the diameter of the Tru-Lay cable and are fitted with machine-cut grooves to prevent the cable from overlapping. The drum flanges are guarded so that the cable cannot wedge between the drum and the hoist frame.

The mechanical holding brake, adjustable from the outside, runs in oil, as do all the gears of the hoist. The motor, drums and drum-pinion bearings have Alemite fittings to prevent danger from oil leaking at these points.

Simplex Nesting Bins

THE sectional bins shown in the illustration, manufactured by Stackbin Corporation, Providence, R. I., and designated as Simplex Nesting bins, are designed for the storage of small parts used in assembling operations, for storing parts produced in quantity to reduce handling, and as storage bins in a stock room.

The bins can be stacked sectionally as illustrated. They are so fabricated that they will not unstack or cannot readily be dislodged when once placed in position. A seam is provided on the top for this purpose and each section must be lifted one out of the other. The metal edges where the hand enters the bin are bent over so that

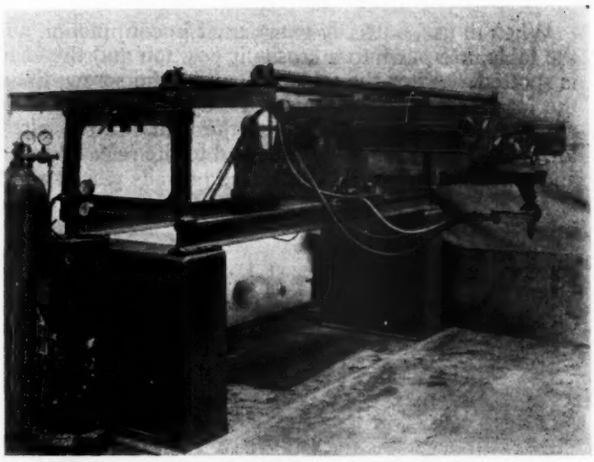


Sectional stacking of Simplex Nesting bins

a smooth rounded edge is presented. The bins are made in four sizes with the following dimensions: No. 1, 4 in. high by 5½ in. wide by 12 in. long; No. 2, 5¼ in. by 7½ in. by 15 in.; No. 3, 6½ in. by 9 in. by 18½ in.; No. 4, 9½ in. by 12 in. by 20 in. These sizes are standard but special sizes can be furnished to meet individual requirements.

Automatic Oxyacetylene Cutting Machine

IN the illustration is shown a combination compound transversing-head and template automatic oxyacetylene cutting machine which is designed to execute practically all forms of cuts. The machine is not simply of the template type, but can be used automatically without a template, with a template, or by hand guidance.



The transversing-head and template automatic oxyacetylene cutting machine

All parts of the machine which are not subject to wear are made of the light metal, Silumin (Alpox).

It has a built-in ¼-hp. motor which can be supplied in any voltage, cycle or phase and is directly connected to a stepless friction drive capable of moving the burner at any desired speed to suit the thickness of the metal. The speed is adjustable by means of a hand wheel and may be read from a tachometer placed above the machine where it can be seen by the operator at all times. All control levers are within easy reach of the operator to insure rapid manipulation of the machine.

The cutting capacity of the machine is unlimited, as the whole machine moves along the track for cutting of this kind. There are a number in use in Germany with tracks 60 ft. long. The cross cuts are made by the torch holder moving in or out on the transverse head, which allows the machine to cut right angles, 45-deg. angles and straight lines, going from one kind of cut to the other by the turn of a lever and without interrupting the cutting. All circles are automatically made without a template by setting the circle gage for the proper size.

This machine is made in 39-in., 54-in. and 79-in. sizes, the difference being in the length of the transverse head. It is marketed by Jos. C. Paulus & Co., 2507 Potter street, Philadelphia, Pa.

The Whiting Single-Screw Drop-Pit Table

IN the illustration is shown a single-screw drop-pit table designed for use in the coach yard. It is the product of the Whiting Corporation, Harvey, Ill., and consists of a standard screw unit with a V-shaped block top which raises the wheels at their axle center. The screw is stationary but the block can be swiveled as desired. Only the worm-gear case is above the platform top; the motor and gear reductions are located beneath it. A dirt-proof case extends below the table, enclosing the screw at its lowest position. The screw nut and gear reductions are enclosed and operate in an oil bath. The screw is mounted on a solid structural frame fitted with trucks which are equipped with roller bearings. The screw of the table illustrated is operated by a 5-hp. motor, has a lift of approximately 40 in. and travels 16 in. per min. with a rated capacity of 15 tons. The secondary pit used in conjunction with the table is 24 in. deep.

When in use, butterfly gates, used in conjunction with the table, are put into a cross-pit position and the coach is spotted. After the table is spotted, the screw, lifting the load of one wheel, raises the spotted wheels above gates. The gates are swung to the wall and the wheels lowered. The table is then moved to the releasing track and wheels are raised and released on rails placed across

The Whiting single-screw drop table for passenger coach yards

the pit. The table can be readily moved and can serve any number of coach tracks.

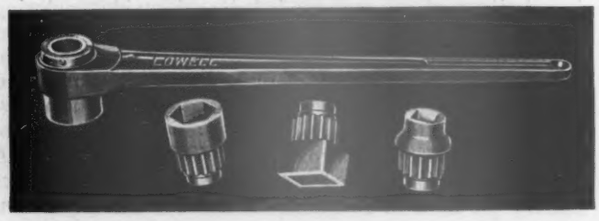
The screw is self-locking; when the motor stops the load stops, controlled by means of a Whiting push-button remote control. The platform top is made of heavy planks, extending the full width of the pit and well beyond the coach trucks on each side. This design provides a working platform on which men can stand while completing every job except moving the table.

The Lowell Reversible Ratchet Socket Wrench

THE reversible ratchet socket wrench shown in the illustration is a recent development of the Lowell Wrench Company, Worcester, Mass. The wrench has a 24-in. safety steel handle with interchangeable sockets having capacities of ⅝ in. to 1¼ in. square or hexagon nuts. The handle is made of electrically heat-treated metal and is designed with an improved grip to facilitate handling by the operator.

The wrench has enclosed pawls of hardened steel to increase the service life of the tool by the elimination of all dirt from the operating part of the wrench. The pawl mechanism itself is under a crushing stress throughout with no shearing stress. It can be reversed without being removed from the work by throwing a small shipper or reversing lever near the end of the handle. The sockets are removable and interchangeable by taking off the retaining collar which allows the socket to slip out and the new one to be fitted in.

The tool can be used on locomotive frame work for drawing up fitted frame bolts, for tightening saddle bolts and steam-dome cap bolts and also in air-pump, feedwater-heater, stoker and booster repairs. It also serves as a general utility wrench for bolting pipe flanges on construction work, in enginehouses and on car construction.

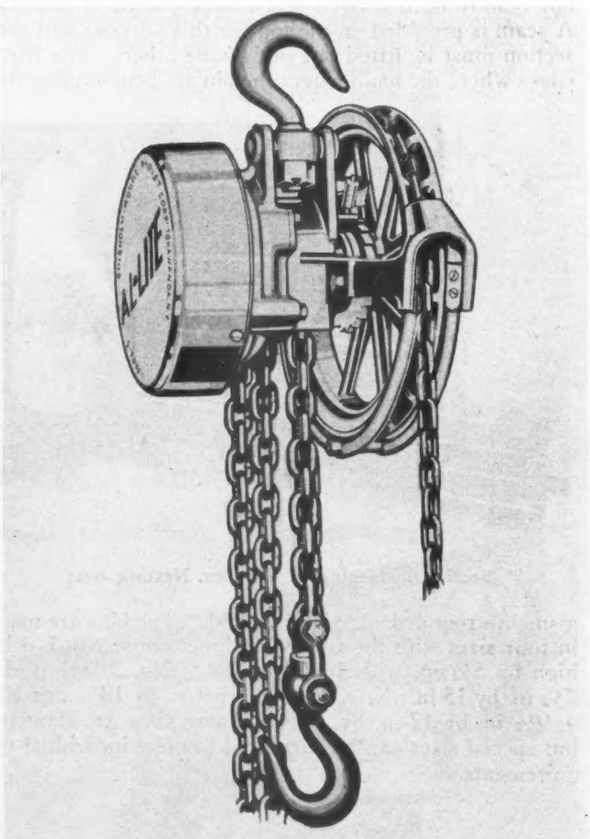


The Lowell reversible ratchet socket wrench

Aluminum-Alloy Chain Hoist

THE Chisholm-Moore Hoist Corporation, Tonawanda, N. Y., is manufacturing a chain hoist constructed of aluminum alloy. The hoist, designated as the Al-Lite chain hoist, is designed to be one-third lighter than other chain hoists to enable one man to carry it and hang it in place.

The Al-Lite hoist is provided with Alemite lubrication, and is fitted with hardened and ground ball bearings, planetary type gears and a dust-proof housing ad-



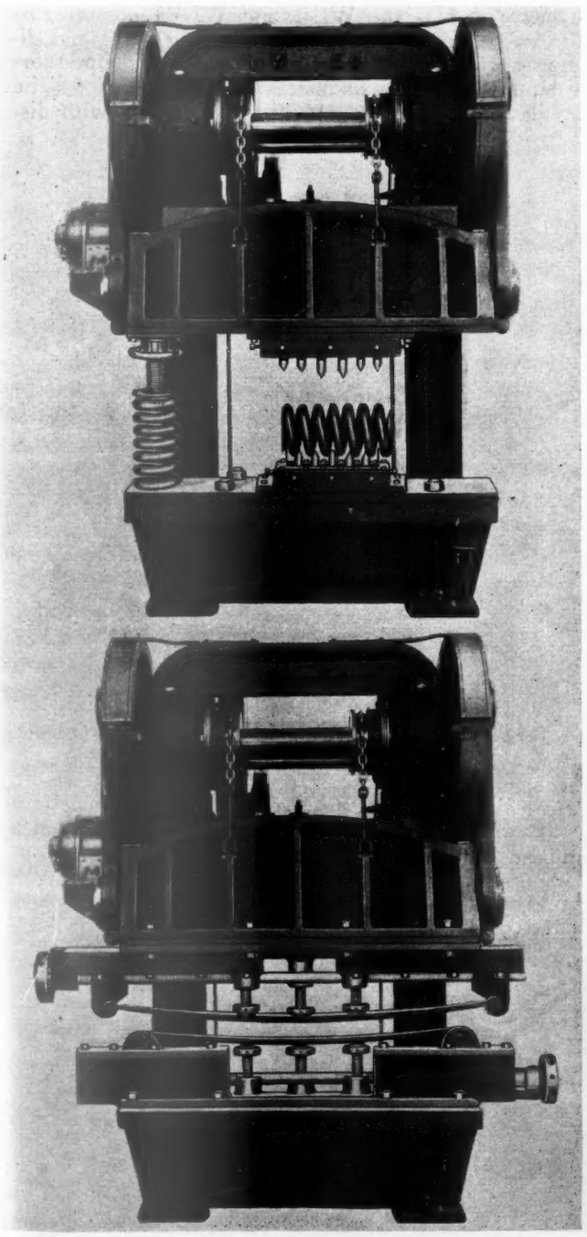
The Chisholm-Moore Al-Lite chain hoist

justable brake. It is equipped with Inswell chain and is tested at 50 per cent overload.

The hoist is made in ¼-ton, ½-ton and 1-ton capacity sizes. The ¼-ton size has a gross weight of 45 pounds and requires a 45-pound chain pull to the lift capacity load, 12½ feet of chain being handled to lift the capacity load 1 foot.

Spring Dies For Vertical Bulldozer

IN conjunction with its vertical type bulldozer, Williams, White & Co., Moline, Ill., have recently brought out improved dies for reclaiming flat and coil springs for locomotives and cars. When using the dies for reconditioning coil springs, the spring is first heated, set in a horizontal position and spread slightly beyond its free working height. The spring is then set in a vertical position as illustrated, and on the down stroke of the ram it is brought to its finished length, after which it is tempered. The dies are adjusted by set screws and are so designed that the fingers each move the proper distance in relation to each other so that, when they are locked they are the same distance apart, thus requiring only one set of dies for various size coil springs.



Spring dies used on Williams, White & Co. vertical bulldozers for working coiled and elliptical springs

In another illustration is shown a die which is designed for reclaiming flat and elliptical springs. The top die as shown is tempered practically straight so that it is necessary to pull the two ends together to get a radius. The bottom die is tempered with an excess radius and must be pulled apart to get the proper radius. The jack screws in the center are used simply for supporting the springs under load, it being necessary to loosen them to adjust the dies. The proper radius of the dies is secured by setting the jacks against a spring by hand, tightening or loosening the wheels as desired until the proper radius is reached. The spring leaves are worked while hot and are laid on the dies, the stroke of the machine setting them to the proper radius. When removed they are thrown in the tempered solution.

The machine on which the dies are used is made single or double-geared to operate at from 10 to 30 strokes per minute but it can be furnished with a two-speed drive to operate at 10 and 20 strokes per minute. The machine can also be furnished with a hand clutch control or with a treadle control, with an automatic stop at the top of the stroke. It is made in Nos. 53 and 54 sizes which have capacities of 50 and 85 tons, respectively.

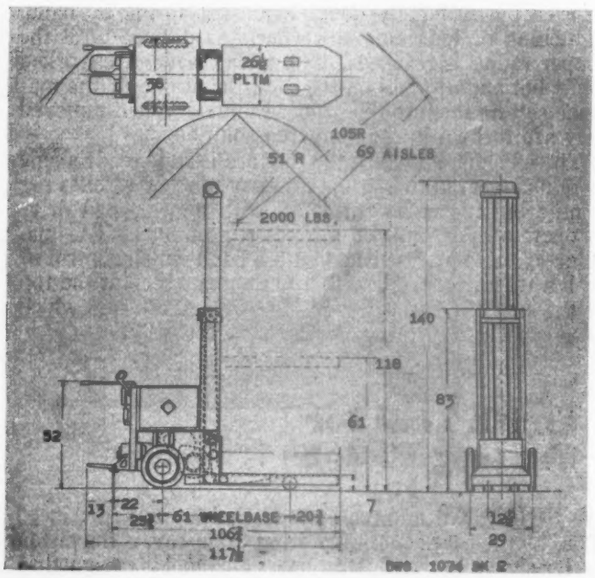
Smith Tool for Parting Pistons

A RECENT addition to the Smith tools, produced by the Clark Manufacturing Company, is the piston parter shown in the illustration. This tool is designed so that in parting the piston the bell of the crosshead takes the full pressure of the load. The tool, designated as the Strong-Back piston parter, is constructed of a yoke which fits over the bell of the crosshead, a yoke hung from the top guide back of the crosshead and two connected sections which parallel the crosshead sides. Fitted to the rear yoke is a hydraulic cylinder and piston operated by a ratchet wrench, the piston of which is set against the end of the locomotive piston rod. As pressure is applied the load is taken by the yoke set against the bell of the crosshead. The tool develops 150 tons pressure and is designed for parting rods from the smallest to the largest sizes.

The Smith Strong-Back piston parter

Elwell-Parker High-Lift Truck

THE Elwell-Parker Electric Company, Cleveland, Ohio, recently brought out a high-lift tiering electric truck with telescoping uprights. It is designed for placing loads in tiers or stacks and for loading or unloading cars from rail level, loading or unloading motor trucks from street level, icing cars, etc.



Drawing showing the dimensions and operating limits of the Elwell-Parker high-lift truck

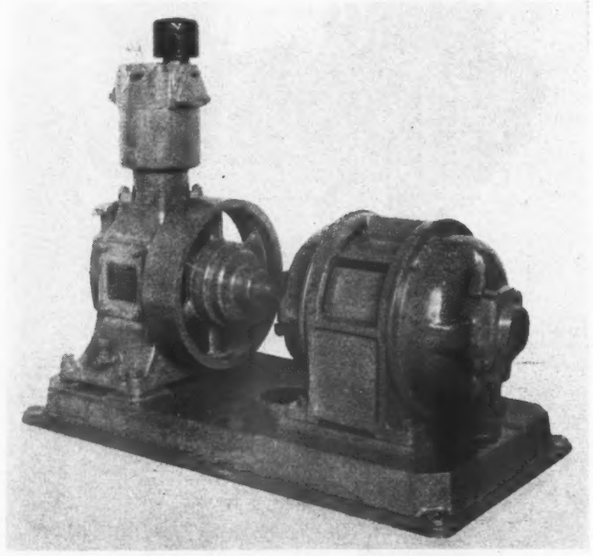
The electric truck illustrated is 3 ft. 2 in. wide, 9 ft. 4 in. long with a 26 in. by 54 in. platform that tiers in the open to a height of 10 ft. yet will pick up its load of 4,000 lb. at 7 in. above the floor in a railroad car with 83 in. inside height. It is designed with primary and secondary uprights, the latter of which does not begin to rise until the platform reaches a height of 61 in. This feature enables the truck to stack merchandise to the roof of a box car. The truck is capable of elevating a load to a height of 118 in., but with the uprights in a lower position, it may be driven through a 7 ft. door, 42 in. wide. Independent control of brake and power for ramp performance is employed. The travel, hoist and tilting or auxiliary loading and unloading attachments are all driven by fuseless motors.

The truck steers on all four rubber tired wheels and is designed to operate in 70-in. aisles. It is equipped with standard automatic safety control of travel and hoist motors, and with cable lift, automatic elevating, hoist limit, cutouts, and either Edison or Exide batteries or Ready Power gas-electric equipment.

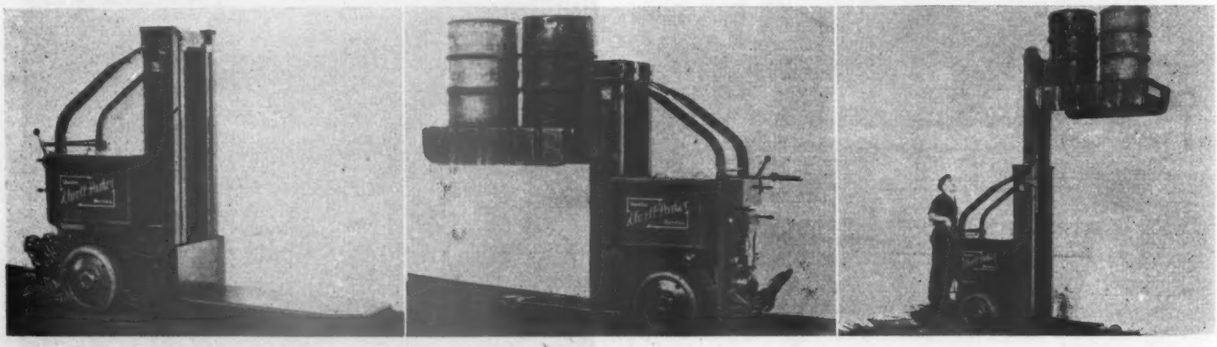
The truck is built in sizes of 3,000, 4,000 or 6,000 lb. capacity sizes and with platforms 7 in. or 11 in. high.

Sullivan Single-Acting Air Compressors

THE Sullivan Machinery Company, 400 North Michigan avenue, Chicago, has recently introduced two single-cylinder, single-acting vertical air compressors, supplementing its two-cylinder and four-cylinder units of the same general types. These compressors are designated as the WL-1 and WL-11 compressors and can be furnished for belt or V-belt drive and direct-motor drive. The belt-driven WL-1 compressors are built with piston diameters and strokes of 5½ in. by 5 in. and 6½ in. by 5¼ in., respectively, with displacements ranging from 27 to 62 and 40 to 91 cu. ft. of free air per min., respectively, with speed variations of 400 to 900 r.p.m. When V-belt drive is desired a sub-base is available on which the compressor motor



The Sullivan W-11 single-acting air compressor



The Elwell-Parker high-lift tiering truck of 4,000-lb. capacity designed with telescoping uprights for elevating its load to a height of 118 in.

and V-belt drive are mounted. The W-11 direct-connected motor-driven units, with a 60-cycle a. c. motor, are built in sizes having capacities of 60 and 88 cu. ft, of free air per min., respectively. Twenty-five-cycle a. c. motors and d. c. motors may also be furnished if desired.

Both the belted and direct-connected models can be equipped with automatic start and stop control for either wide or close regulation, as required by service conditions. The larger of the two belt-driven units occupies 19-in. by 21-in. floor space and is 43 in. in height. The WL-11 units, including motor and sub-base, are 53 in. long by 27 in. wide, with an overall height of 47½ in. Both units are capable of maintaining a maximum air pressure of 125 lb. per sq. in.

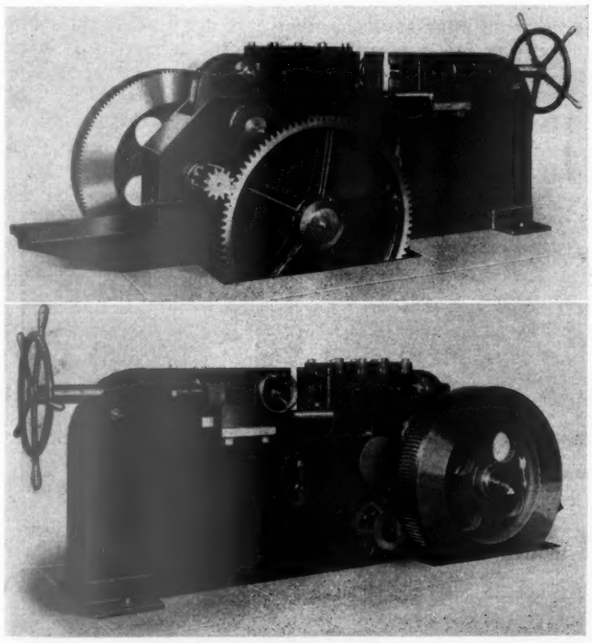
The units are equipped with Sullivan automatic water valves of stainless steel, providing low lift with wide port opening, and a small clearance factor.

Buffalo Armor-Plate Straightening Machine

A MACHINE designed along the lines of a horizontal punch for straightening axles, rails, beams, channels, tees, etc., has recently been placed on the market by the Buffalo Forge Company, Buffalo, N. Y. The machine is fitted with pressure blocks which are adjusted by means of a hand-wheel and which move in unison to insure equal spacing. The carriage of the machine is graduated and capacity tables are furnished to indicate what sections may be bent on any given centers. The carriage is adjusted by means of a large hand-wheel and heavy screw. The adjustment is sufficient to permit sections of maximum size between the pressure blocks. Operation of the machine is continuous, there being no gags or clutches.

The plunger slides between the frames and is gibbed on both sides with bronze liners. The three pressure blocks are of hardened alloy steel and their standard shape may be changed to suit special conditions. The machine is provided with rollers to facilitate the handling of different materials as they pass through the machine.

One of the features of the machine is the Armor-Plate electrically welded frame which is guaranteed against breakage. The table is a heavy steel plate welded between the frames. The gear is a steel casting while the pinion is a nickel-steel forging, cut teeth being used throughout. The shafts are alloy-steel forgings. The machine is Alemite lubricated throughout except the flywheel bearing which is of the ring-oiling type. The machine is made in three sizes, No. 47, 48 and 50 respectively, the specifications of which are given in the table.



Buffalo machine for straightening axles, rails, beams, etc.

Self-Propelled Riveting Truck

AN unusual application of the industrial-truck principle to cut production costs is the self-propelled riveting truck recently developed by the Mercury Manufacturing Company, Chicago. The design is known as the Mercury ES-513 rivet-press carrying truck. The truck is 55 in. wide by 76 in. long and carries a tower structure 114 in. high. The tower supports an I-beam that extends 95 in. each side of the tower center. Chain block trolleys which carry portable pneumatic riveting presses of 25 tons capacity ride on this beam.

The riveting truck is operated by a 220-volt d.c. motor which drives it through a worm-driven rear axle. The current is brought to the truck by a cable on a take-up reel. The cable is arranged to be plugged into a standard 220-volt supply line which is available where the truck is being used. There are two speeds forward and two reverse.

When in use the truck carrying the two riveting presses is slowly moved up and down the aisleways where routine rivet work is being done or where structural beams are being fabricated. A crew of men

Capacities of Buffalo Straightening Machines

No. of Machine	47	48	50
Distance between blocks	6 in. to 14 in.	8 in. to 16 in.	8 in. to 18 in.
Straightens beams up to	6 in. to 17.25 lb.	9 in. to 30 lb.	10 in. to 35 lb.
Straightens channels up to	7 in. to 19.75 lb.	10 in. to 35 lb.	12 in. to 35 lb.
Straightens angles up to	5 in. by 5 in. by ⅝ in.	6 in. by 6 in. by 1 in.	8 in. by 8 in. by 1 in.
Straightens angles up to	6 in. by 4 in. by ⅝ in.	8 in. by 6 in. by ¾ in.	8 in. by 6 in. by 1 in.
Straightens tees up to	all	all	all
Maximum section modulus	9.5	23.1	29.9
Ram pressure	80 tons	130 tons	190 tons
Number of strokes per minute	40	35	35
Height of strokes	1 in.	1⅛ in.	1¼ in.
R.p.m. of flywheel	300	300	300
Pulleys	18 in. by 3 in.	20 in. by 4 in.	26 in. by 4 in.
Hp. of motor	5	7.5	10
Length	9 ft. 6 in.	11 ft. 6 in.	13 ft. 6 in.
Width	2 ft. 10 in.	3 ft. 4 in.	4 ft. 0 in.
Height	2 ft. 3 in.	5 ft. 0 in.	6 ft. 3 in.
Weight	6,850 lb.	11,000 lb.	16,500 lb.

working on either side can move the press easily and conveniently to the exact location where the rivets are to be driven. The speed of travel of the riveting truck is controlled by push-button stations carried on the belt of one of the men working on the riveting press. In this way a very convenient and rapid handling of the riveting operations is obtained.

When the truck has to be moved over a longer distance than normal, the operators can take their places

The Mercury ES-513 self-propelled truck for carrying riveting presses

on the machine and drive the truck at three or four miles an hour. The truck is provided with special guards which push discarded rivets and scrap metal out of the way as the truck travels.

Attachments for the Ohio Super-Dreadnaught Shaper

SINCE the 36-in. Ohio Super-Dreadnaught shaper was placed on the market, four new attachments have been developed by the Ohio Machine Tool Company, Kenton, Ohio, adapting this tool to a more diversified service on locomotive repair work.

With the shell or crown-brass attachment, illustrated in Fig. 1, any size brass can be machined to a smooth finished surface of any radius. This fixture is fitted with machine surfaces for the use of gages and can be operated either by hand or power. This method of shaping a shell permits a tighter fit in the driving box. The average time required on normal size driving-box crown brass as established by tests is 30 min. floor-to-floor time.

The shoe and wedge chuck, shown in Fig. 2, is made in two sections for easy handling and is universal in that various types and sizes of shoes and wedges can be held on it. It can be adjusted on the shaper table to suit requirements of the job. There are screws in the lower section which can be adjusted to obtain different angles for machining the shoes and wedge. A check of time in using this attachment showed 20 min. each for machining cast-iron shoes and wedges, 6¾ in. wide by 22 in. long, including shaping the box face to line and filleting two corners.

The illustration shown in Fig. 3 is a main-rod brass attachment. There are absolute stops for every 90-deg. turn of the attachment so that work can be planed square without referring to the graduated dial. If it is necessary to plane a brass to any intermediate degree, it is only necessary to revolve it to the degree

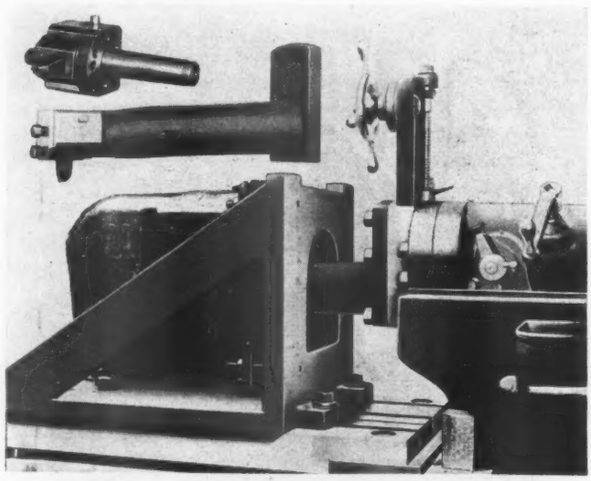


Fig. 4—The fixtures and head for machining electric locomotive driving-wheel boxes for roller-bearing fits

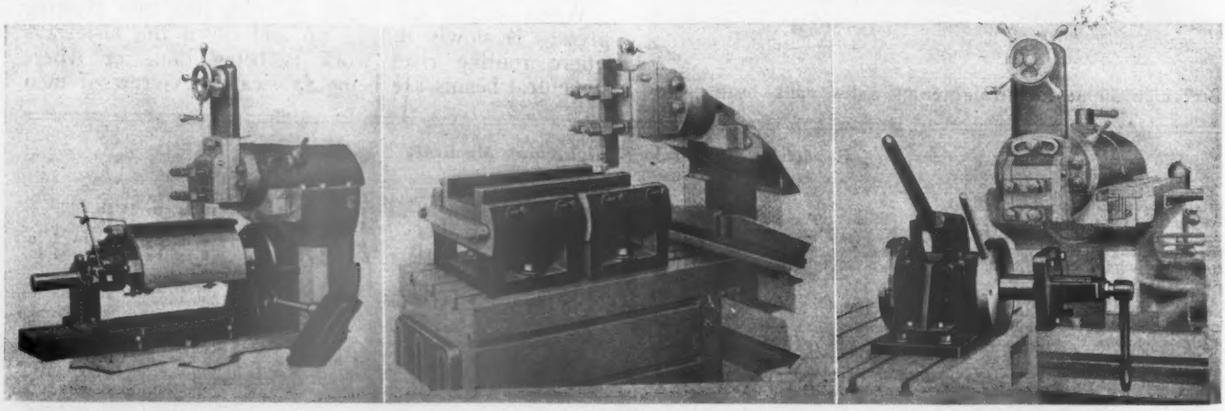


Fig. 1, Left: The crown brass attachment—Fig. 2, Center: The shoe and wedge chuck—Fig. 3, Right: The main-rod brass attachment

required and pull down the locking lever. The reported test time for machining a main rod brass with a 6-in. jaw is 25 min., including shaping the wedge fit, ends and sides, finishing the top of the flange and shaping the strap fit.

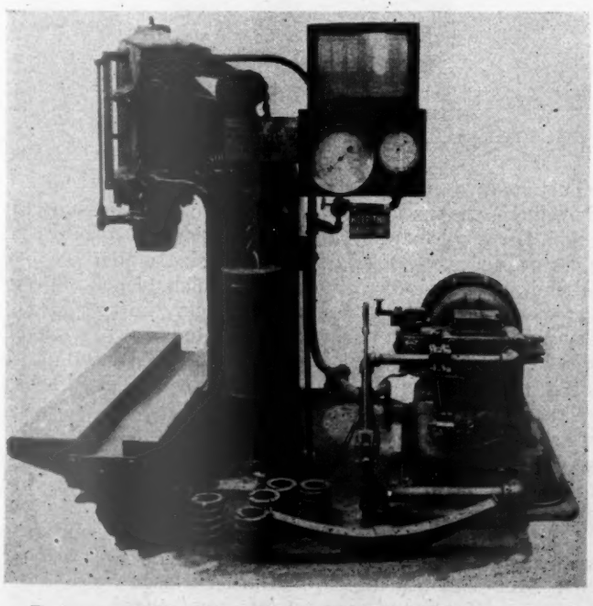
Fig. 4 shows fixtures and a head for machining electric-locomotive driving-wheel boxes for roller-bearing fits. Tools and fixtures adaptable to all classes of electric motor cars can be furnished. These attachments can be secured from Joseph T. Ryerson & Son., Inc., general distributors of Ohio shapers.

Ryerson Machine for Testing Springs

A MACHINE for testing all types of railroad springs has been designed recently for the New York, New Haven & Hartford by Jos. T. Ryerson & Son, Inc., Chicago. This special spring tester, which is in use in the Van Nest shops, New York, embodies several outstanding features. The machine is operated by hydraulic pressure furnished by a self-contained motor-driven Oilgear unit which is mounted on the machine, instead of by an accumulator, thus saving floor space otherwise required by the accumulator and connecting pipes. In spring testing work it is often desirable to hold a spring under pressure for a specified length of time in order to provide a more accurate test. Through the use of the Oilgear system a spring may be held deflected at any desired pressure for three or four minutes at a time. A maximum pressure of 50 tons is developed at 1,500 lb. per sq. in.

The machine is arranged for testing full-elliptic springs for passenger cars as well as semi-elliptic locomotive and coil springs. The frame has an 11-in. throat and a work table 25-in. wide which makes it practical for testing these varied types of railroad springs. Both the frame and the work table are made of cast steel, offering ample resistance against the heavy loads imposed upon them.

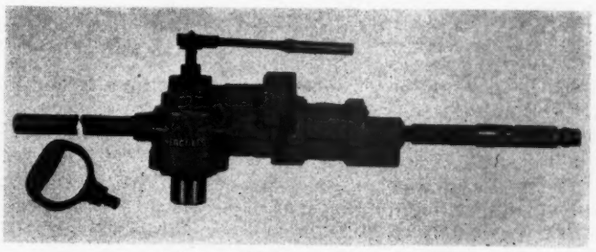
A scale is mounted on the overhead ram cylinder to indicate the deflection of the spring being tested. As the ram moves down, deflecting the spring, an adjustable pointer moves with it and shows the exact deflection on the scale. A large pressure gage, having two dial readings, indicates the pressure in pounds per square inch and the total pressure of the ram in pounds.



Ryerson machine for testing elliptical and coil springs

Hercules Heavy-Duty Drill and Reamer

THE Buckeye Portable Tool Company, Dayton, Ohio, has added to its present line of Hercules portable air tools a heavy-duty drill and reamer of exceptionally light weight. This tool is also made for nut driving, and is designed for structural steel work, ship building, railroad shops, and builders of heavy machinery. Its weight is 40 lb., which is approximately half of the usual weight of tools of its capacity.



The Hercules No. 287-5 heavy-duty drill

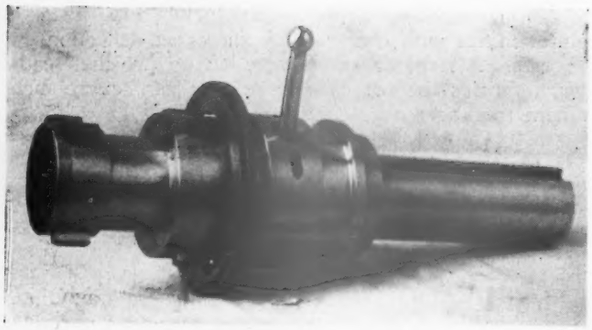
The No. 287-3 drill and No. 288-3 nut driver have a speed of 120 r.p.m. The No. 287-5 drill and No. 288-5 nut driver have a speed of 68 r.p.m. The drill is equipped with a No. 5 Morse taper socket and the nut driver with a ⅞-in. square spindle. The feed is controlled by a ratchet wrench, although a spade handle or breast plate can be used in place of the rachet. The Hercules stationary-valve motor is used to give this tool the greatest torque possible at its speed. The tool illustrated is the No. 287-5 drill.

Combination Geometric Collapsing Tap

THE Geometric Tool Company, New Haven, Conn. has recently developed a special combination collapsing tap for cutting two diameters at one time. The tap illustrated is known as a 3-in. and 4-in. Class SD Tap, being equipped to cut 3 1/16 in.—12 U. S. threads and 4⅝ in.—12 U. S. threads at the same time. The chasers engage with the work simultaneously, or at such pre-arranged points as is necessary in order for the chasers to finish threading at the same time.

In using a tap of this kind, the pitch of the two threads and 4⅝ in.—12 U. S. threads at the same time, must be far enough apart to permit the use of two sets of chaser slots and also two complete plungers for holding the chasers in the tool, but not so far apart as to cause excessive overhang.

While the tool is used in a stationary machine as a plate trip, hand reset type, it can be installed on a chucking machine used as a rotary top plate trip, automatic reset. In other words, it has the universal application such as found in the standard line of Geometric Class S taps.



The Geometric class SD 3-in. and 4-in. collapsing tap

The chasers have independent size adjustment. Those in front are adjusted through the medium of an adjusting ring located on the back part of the body of the tap. Both sets of chasers collapse at the same time, collapsing action being brought about either through the contact of the trip plate with the face of the work, or through the use of a fork operating in the groove of the closing sleeve. This combination tap can be used for straight hole tapping, or can be used for cutting taper threads, such as pipe threads, thus permitting work to be done in a single operation, which formerly required two operations.

The Cesco M & L Goggles

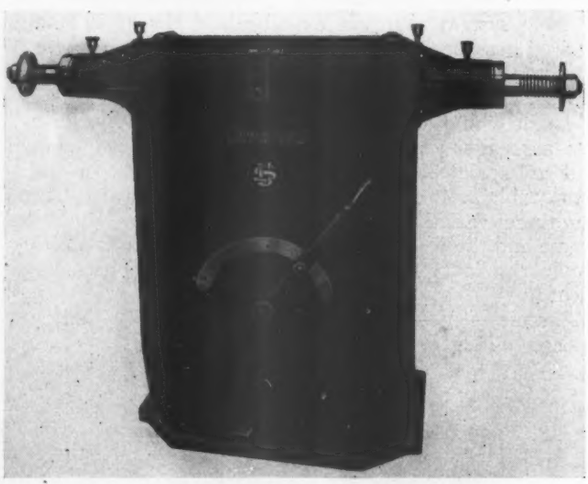
THE Chicago Eye Shield Company, 2300 Warren boulevard, Chicago, Ill., recently placed on the market a pair of goggles designed to fit over a workman's glasses. The channels of the goggles are shaped to prevent pressure on the workman's temples, and the cups are tapered to allow them to fit over the largest spectacles. The cups extend over the nosebridge to prevent foreign matter from entering the eye. The nosebridge and headbands are so shaped as to permit adjustment to any face, while the inner part of the cup fits over the nosebridge in such a manner as not to interfere with adjustment or focus. The goggles are made of moisture-proof composition material and are standardized so as to permit the interchangeability of parts.

The Cesco M & L goggles for fitting over workmen's spectacles

The goggles are furnished in the following three styles to meet various requirements: A ventilated pattern fitted with Super-safety lenses for chipping, grinding, caulking, riveting and like operations; a dust model fitted with Super-Safety lenses, and a welders' pattern fitted with Cescoweld lenses for acetylene welding and cutting.

U. S. Multispeed Buffer and Polisher

THE United States Electrical Tool Company, Cincinnati, Ohio, recently added to its line of products its Multispeed buffer and grinder which is provided with four different wheel speeds ranging from 2,000 r.p.m. to 3,000 r.p.m. The machine maintains a constant wheel-surface speed regardless of wheel wear and is driven by means of a Gibbs V-disc transmission of graphitized micarta. The transmission consists of a cone or series of discs of different size which revolve on the motor spindle, any one of which, depending on the speed desired, can be inserted quickly into a stationary metal V-disc or sheave, mounted on the wheel spindle, by releasing the cone with a foot pedal and moving it into the desired position by means of a hand lever on the front of the machine. The motor and disc cone are mounted on a rocker arm so that they may be easily moved along the mounting, parallel with the wheel spindle. Changes in speed are made only when the motor and wheels are not in motion.



The U. S. Multispeed buffer and polisher

The buffer consists of a heavy one-piece chrome-manganese-steel wheel spindle supported on four heavy-duty SKF ball bearings which are enclosed by a laby-

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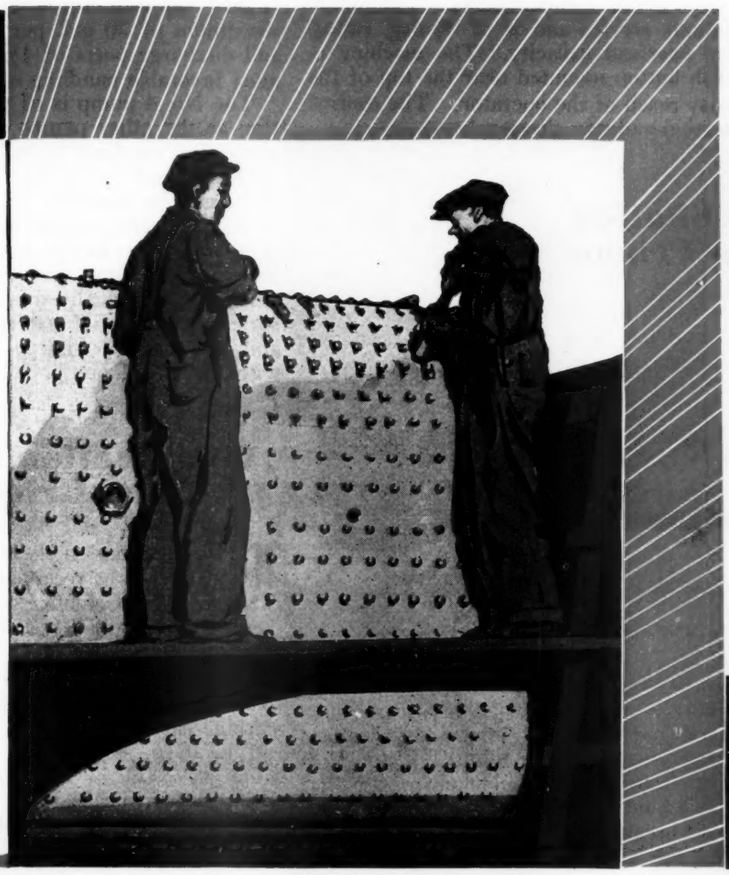
TONCAN COPPER Molybdenum IRON



AGATHON NICKEL IRON

modern

Locomotives Ask A Lot From Staybolts

Up go boiler pressures! Fireboxes increase tremendously in size. Staybolts are stressed more and more. • These new responsibilities have focused attention on the staybolt. • Where greater toughness is essential, railroads are specifying staybolts of Agathon Nickel Iron. Without sacrifice of the desired fatigue resistance these staybolts are substantially stronger than ordinary staybolts. • But where iron staybolts are still preferred, Toncan Iron offers several advantages as a staybolt material. It is uniform in composition and due to the alloying of refined iron, copper and molybdenum, possesses a superior resistance to corrosion. Toncan Iron is the modern staybolt iron.

CENTRAL ALLOY DIVISION
REPUBLIC STEEL
CORPORATION
Massillon, Ohio

rinth seal in dust-tight grease compartments. The motor is built for continuous service and is of 40-deg. rating with a momentary overload capacity. The machine is controlled by a push button mounted near the top of the machine, within easy reach of the operator. The control has overload protection and no-voltage release.

Starrett Shallow Hacksaw Frame

A HACKSAW frame of unusual design has recently been introduced by the L. S. Starrett Company, Athol, Mass. The frame, shown in the illustration, has a throat just deep enough to accommodate the blade, with

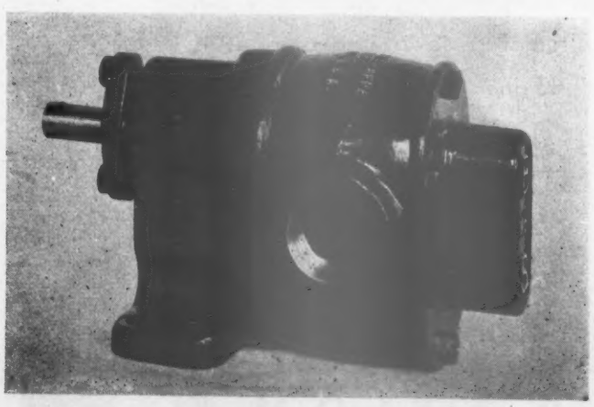
The Starrett No. 150 shallow-throated hacksaw frame

the result that cuts can be made in spaces offering hardly more than 1 in. clearance. This construction also results in improved balance and rigidity, making the frame adaptable for cutting small pipe, conduit, BX tubing, insulation, etc. The frame has no tendency to wobble on shallow cuts of this kind, blades can be strained tighter with less danger of breakage, and the cut can be made with one hand, with the other hand free to steady the work.

This hacksaw frame, designated as No. 150, is fitted with the usual Starrett four-way blade adjustment.

Brown & Sharpe Geared Coolant Pump

THE Brown & Sharpe Manufacturing Company, Providence, R. I., is prepared to furnish a pump of larger capacity than the Nos. 1, 2 and 3 gear pumps regularly in its line. This pump, which is known as



The Brown & Sharpe No. 4 geared coolant pump

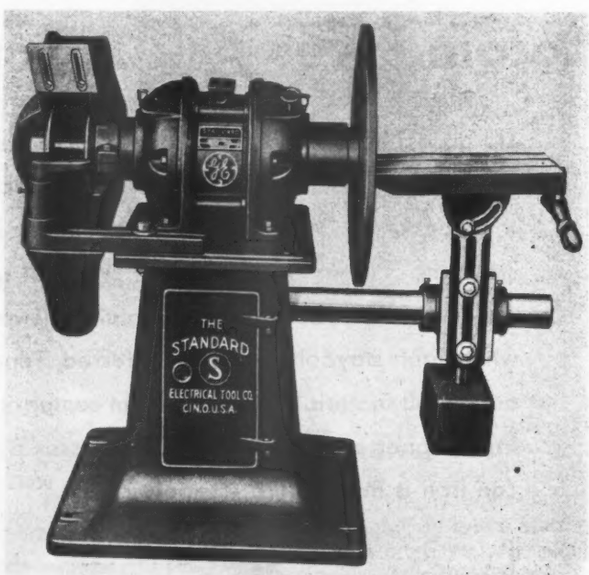
the No. 4, has a capacity of 15 gals. per min. at 500 r.p.m., with a corresponding increase in discharge of 3 gals, per min. for each 100 r.p.m. increase up to a maximum of 30 gal. per min at 1,000 r.p.m. Suction and discharge ports of 1¼-in. pipe size provide for the most favorable handling of this volume of liquid.

The No. 4 pump is of the same design and construction as the other pumps and is adaptable as a coolant pump for machine tools, as its capacity permits of a copious supply of coolant, either under pressure where such may be desirable as for drilling and flushing out chips, or where a cascade of coolant is desired without pressure. For larger machinery it can be used as a lubricating pump. For use independently it may be furnished electrically driven. Any of the pump accessories, except relief valves, available for the Nos. 1, 2 and 3 Brown & Sharpe geared pumps may be used with the No. 4 pump.

Combination Floor and Disc Grinder

THE combination electrically-driven grinder and disc grinder is a recent development of the Standard Electrical Tool Company, Cincinnati, Ohio, and is manufactured in three sizes. The 3-hp. machine carries emery wheels on one side 14 in. diam. by 2 in. face, with 1⅛-in. bore. On the opposite side it carries a steel disc 14 in. in diameter by ½ in. thick. The 5-hp. machine carries emery wheels 18 in. diam. by 3-in. face and an 18-in. steel disc ⅝-in. thick. The 7½-hp. machine has 20-in. by 3-in. emery wheels and a steel disc 20 in. in diameter and ¾ in. thick.

General Electric completely-enclosed motors with push-button controls are used. The spindles are mount-



The Standard combination floor and disc grinder

ed in SKF ball bearings with an extra SKF ball thrust bearing to take care of the end thrust created by the load on the steel disc. All of these bearings run in oil and are mounted in dust-proof chambers. The spindle is made of nickel steel. The table on the machine is of the lever-feed type and may be adjusted to any angle.

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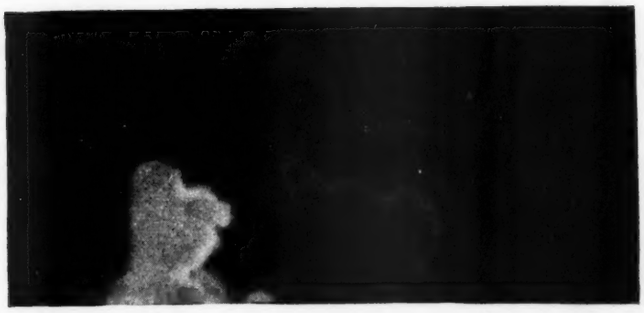


USE SUPER-POWER INTENSIVELY

for Maximum Net on Reduced Traffic

■ WITH A falling-off in gross, many railroads are keeping up their net surprisingly well.

This is particularly true of roads with progressive motive power policies. Today the proportion of freight handled by modern and efficient locomotives is much higher than before. This is due to intensive use of Super-Power, while less efficient locomotives have been retired as traffic declined.

As traffic picks up you will waste your increasing gross if you return these older locomotives to service.

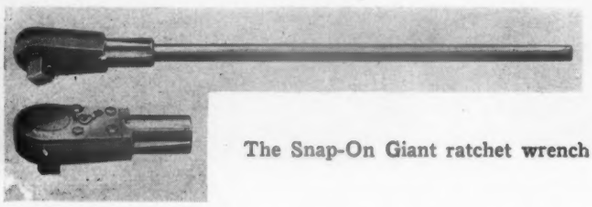
Keep the obsolete types in the back yard where they belong, and buy Super-Power to continue to receive maximum net as business resumes.

LIMA LOCOMOTIVE WORKS INCORPORATED

LIMA LOCOMOTIVE WORKS
Incorporated
LIMA - - - - - - - - - OHIO

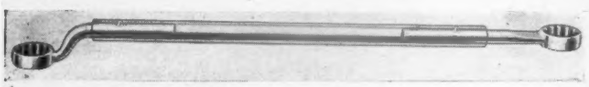
Snap-On Ratchet and Boxocket Wrenches

THE Motor Specialty Company, distributors, 2025 Michigan avenue, Chicago, has recently added to its line the Giant ratchet wrench and the heavy-duty Boxocket wrench shown in the illustrations, both of which are manufactured by Snap-On Tools, Incorporated, Kenosha, Wis. The head of the Giant ratchet



The Snap-On Giant ratchet wrench

wrench is detachable from the handle and is a solid forging with one cover plate which is bolted on the back. A smaller level is provided for reversing the action of the ratchet. The handle is a 32 in. solid round bar of heat-treated high-carbon steel and is attached to the head



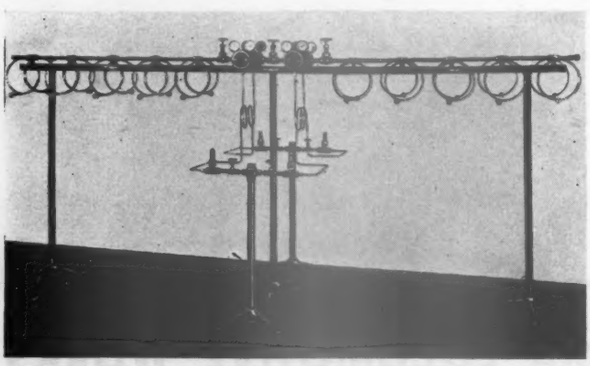
The Snap-On heavy-duty Boxocket wrench

by means of a locking button designed to prevent slipping under load.

The heavy duty Boxocket wrench is designed to fit over nuts in such a manner that the wrench will not slip. The head locks on a tubular handle by means of a safety locking button and is made in straight and offset styles. The wrench head, made in 44 sizes to fit on tubular handles of six different lengths, is especially applicable for tightening and loosening all sizes of boiler plugs, the design of the head reducing to a minimum the danger of rounding off the heads of the plugs by wrench slippage.

The Milburn Twenty-Tank Central Manifold

THE Alexander Milburn Company, 1416 West Baltimore street, Baltimore, Md., has brought out a twenty-tank manifold, shown in the illustration. These manifolds are constructed of bronze tubing, Milburn



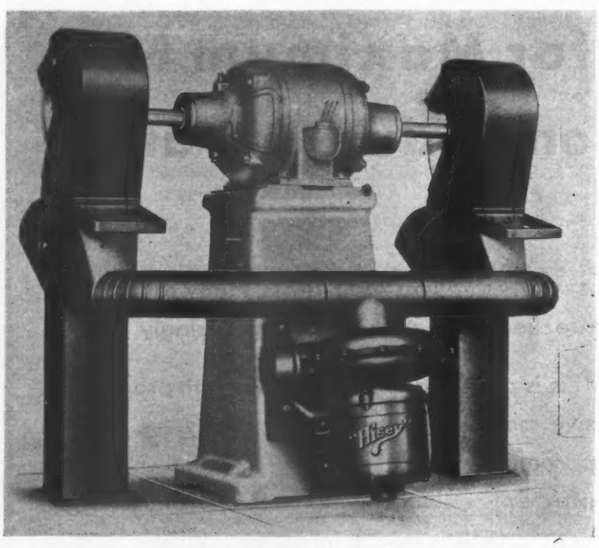
The Milburn twenty-tank manifold used to form a source of supply for cutting and welding torches

standard gas regulators and copper coils. Mounted on a tripod, they form a central source of supply for cutting and welding torches and are used to eliminate the necessity of transporting cylinders about the plant. With them it is possible to maintain an economical and uniform pressure for all operations.

An outstanding feature of the Milburn manifold is that, if desired, each tank or each side of the manifold may be operated independently through separate shut-off valves, thus allowing the torches to continue in operation while the tanks are being connected or disconnected.

Exhaust Equipment For Hisey Buffing Machines

IN the illustration is shown a motor-driven exhaust blower mounted integrally with a Hisey-Wolf polishing and buffing machine. This exhauster has been adopted by the Hisey-Wolf Machine Company, Cin-



The exhauster equipment used with Hisey-Wolf buffing and polishing machines

cinnati, Ohio, as standard equipment on its machines, to be furnished when specified by the purchaser of the equipment. The equipment also includes dust-collecting hoods on the smaller size machines and combination exhaust guards on the larger machines. A filter cabinet, which is used to collect grit and dust, can be supplied when specified.

Ready-Power Units Equipped with Ford Engines

A LINE of gas-electric industrial-truck power plants, in which Ford Model A engines are used, has been developed by the Ready-Power Company, 3820 Grand River avenue, Detroit. These models simplify the servicing of the engine because of the widely available parts service, and the low parts prices.

Two types of Ford engined power plants are offered: One, the FAS line, is equipped for electric starting and ignition, using a six-volt battery, and the other, the

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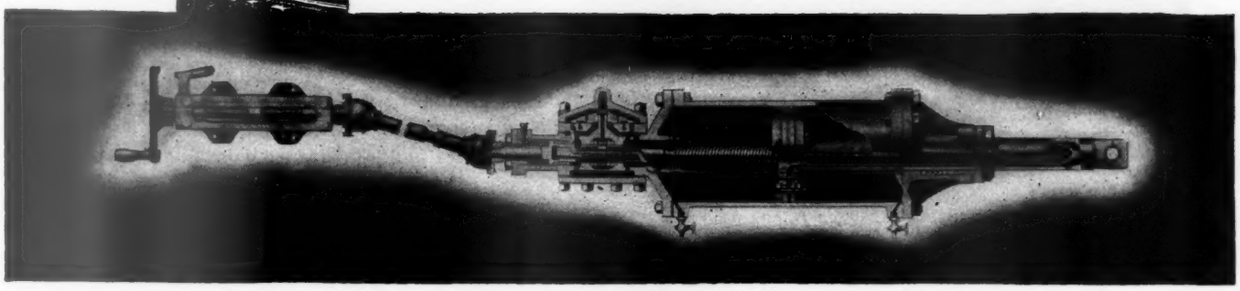
Help the Engineman use Steam Effectively



FRANKLIN PRECISION POWER REVERSE GEARS

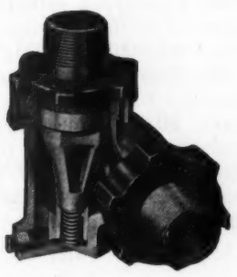
make it easy to get and keep the right cut-off

Great progress has been made in economical steam generation...but how efficiently is this steam used?

To a degree, the answer is in the hands of the engineman—hence the importance of the Precision Power Reverse Gear.

This gear makes it possible for the engineman to secure any desired cut-off with a minimum of physical effort and maintains that cut-off until the engineman wishes to change it. This encourages the engineman to employ his skill to get the utmost work out of each pound of steam.

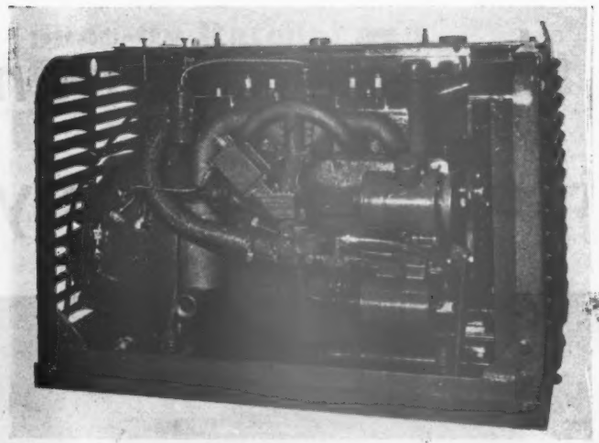
Precision Power Reverse Gear is an essential element in the effort for fuel economy, and requires no emergency steam line since it can be manually operated in the event of air failure.



THE FRANKLIN SLEEVE JOINT assures a full area opening and unrestricted passage for air, steam and oil.

FRANKLIN RAILWAY SUPPLY COMPANY, Inc.

NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO MONTREAL

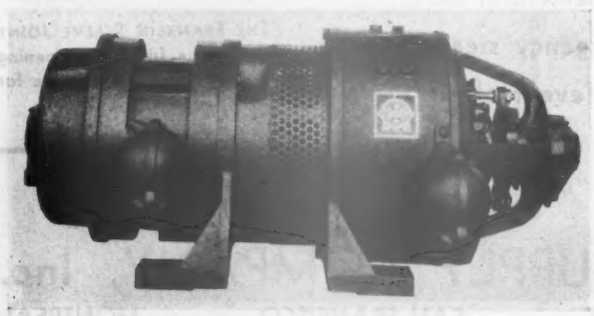


The Ready-Power gas-electric industrial-truck power plant equipped with the Ford Model A engine

FAM line, uses simple magneto ignition. The power generator is wound either for 36 or 48 volts. The model designations for the 36-volt starter and magneto equipped units are FAS-36 and FAM-36, respectively, while the 48-volt units for the starter and magneto equipped plants are FAS-48 and FAM-48, respectively. These models are offered in addition to the standard line of type DB Continental engined units which have been in production for five years.

Reliance One-Unit Motor-Generator Set

A ONE-UNIT motor-generator set for rates from 1 kw. to 5 kw. is shown in the illustration. In this set the usual alternating-current motor and direct-current generator are combined in a single unit requiring only two bearings, one at each end. The induction-motor rotor and direct-current armature are mounted on the same shaft. This design was adopted to provide a compact construction which would require less space than the two-unit sets, and which would eliminate the work of connecting and alining individual units and difficulties arising therefrom. The set, which is the product of the Reliance Electric & Engineering Company, 1088 Ivanhoe road, Cleveland, Ohio, can be furnished for operation on either two-or three-phase circuits of any standard voltage or frequency and has an output rating of 1 kw. to 5 kw. at 125 or 250 volts. It can be furnished with either sleeve or ball bearings as desired.



The Reliance one-unit motor-generator set

Stanley Disc Sander And Electric Saw

THE Stanley Electric Tool Company, New Britain, Conn., has recently brought out the portable electric tools shown in the illustration. The disc sander, designated as the No. 589 9-in. sander, is designed for sanding and cleaning wood or metal preparatory to painting, and also for rubbing and polishing lacquered surfaces. It has an aluminum alloy housing and is powered by a totally enclosed Universal motor fitted with seal-type ball bearings on the armature shaft and spindle to exclude dirt and retain the lubricant. The disc is 9 in. in diameter, is flexible and is designed to permit attaching sanding discs, polishing pads or a lamb's wool buffing bonnet. The disc speed under full load is approximately 1,800 r.p.m. The sanders are made with 110-, 220- or 250-volt motors, and include 12 abrasive discs (six coarse, four medium and two fine).

The Stanley Safety saw No. W6 6-in. weighs 14 lb., has a cutting capacity of 1⅞ in. and a maximum speed

Above: The Stanley No. 589-9 in. disc sander—Below: The No. W6 6-in. Safety saw

of 3,000 r.p.m. It is designed for cutting light lumber, ripping flooring and for miscellaneous cutting on freight-car repairs. The saw has an aluminum-alloy housing; a lubricating system for pumping oil to the worm drive and gears; a momentary-contact double-pole switch, and a guard which covers the blade when the saw is disengaged; a notched base and auxiliary handle to aid the operator in following the cutting line.

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To handle Coal and Cement On the Lehigh and New England

Dimensions and Weights	
Cylinders	30" x 32"
Drivers, diameter	61"
Steam pressure	225 lb.
Grate area	104.4 sq. ft.
Water heating surface	4541 sq. ft.
Superheating surface	1334 sq. ft.
Weight on drivers	373,500 lb.
Weight, total engine	409,000 lb.
Tractive force (main cylinders)	90,300 lb.
Tractive force (with booster)	106,500 lb.

THE LEHIGH AND NEW ENGLAND, which forms an important link in a through route connecting eastern Pennsylvania and the New England States, handles a heavy tonnage of coal, cement and other bulky commodities.

To handle this traffic over the heavy grade sections of the line, two locomotives of the Decapod (2-10-0) type were built in 1927. They met the requirements so successfully that two additional units of similar design were subsequently ordered and are now in service. One of these locomotives is shown in the illustration.

These large locomotives were specially designed to meet definite operating conditions, and their success is due to that fact—plus intelligent handling on the road.

THE BALDWIN LOCOMOTIVE WORKS 1831 1931

THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

Among the Clubs and Associations

A.S.T.M. EXHIBIT.—For the first time in its history, the American Society for Testing Materials will sponsor an exhibit of testing apparatus and machines in conjunction with the annual meeting of the society to be held at the Stevens Hotel, Chicago, June 22-26. The exhibit has been planned with a view to having a distinctly scientific and broadly educational atmosphere, and manufacturers, distributors, and representatives of foreign companies will have equipment on display.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—The annual meeting of the International Railway Fuel Association, usually held in May, has been postponed this year until the third week in September, when a two-day business session will be held, without exhibition or entertainment features. The decision to hold this meeting, which is scheduled for September 15 and 16 at the Hotel Sherman, Chicago, was made at a meeting of the executive committee of the association at Cincinnati, Ohio, on May 11. It was the conclusion of the committee that economies in the purchase, handling and use of railway fuel are of more than ordinary importance at the present time; that the International Railway Fuel Association has, in the past, contributed substantially to fuel conservation progress on the railroads, and that to forego the annual meeting of the association this year would be to lose much ground already gained, to overlook an opportunity for still further reductions in operating expense. In deference to present reduced business activity and the urgent necessity for economy, it was decided to cut the annual convention from four days to two days and limit the addresses and committee reports strictly to those having a direct bearing on fuel performance.

Club Papers

Western Railway Club Elects Officers

Western Railway Club.—Forty-seventh annual meeting and dinner May 22. at the Hotel Sherman, Chicago, the Rev. Ernest F. Tittle, pastor of the First Methodist Church of Evanston, Ill., being the speaker of the evening.

Music for the dinner, which was attended by 400 members and guests, was furnished by a male chorus composed of Chicago & Alton employees. Officers elected for the ensuing year are as follows: President, C. T. Ripley, chief mechanical engineer of the Atchison, Topeka & Santa Fe, Chicago; first vice-president, O. E. Ward, superintendent of motive power of the Chicago, Burlington & Quincy, Chicago; second vice-president, C. M. House, superintendent of motive power and equipment of the Chicago & Alton, Bloomington, Ill.; and treasurer, J. W. Fogg, vice-president of the MacLean-Fogg Lock Nut Company, Chicago.

Chicago Subway Plans Discussed

Western Railway Club.—Meeting, held at the Hotel Sherman, Chicago, Monday evening, April 20, devoted to a consideration of rapidly maturing plans for the new Chicago subway. ¶ A. J. Schafmayer, chief engineer of the Board of Local Improvements, Chicago, presented some of the legal and financial aspects of the development. Alfred Brahdy, resident representative of Robert Ridgway, chief consulting engineer, discussed the design and construction of the subway structure, his remarks being illustrated with informative slides. Harold Otis, engineer of car construction, Chicago Rapid Transit Company, outlined some of the problems to be met in the design of rolling stock best adapted to the particular requirements of this subway installation. All three speakers indicated that the plans in their respective departments are practically completed and, pending favorable court action regarding one detail of the financing, construction work will begin immediately.

Chicago Car Foremen Talk Safety

Car Foremen's Association of Chicago.—Meeting held Monday evening, May 11, at the Great Northern Hotel, Chicago. Subject "Safety First." Address by D. G. Phillips, superintendent of safety, Wabash, Decatur, Ill.

Safe practices as affecting the car department were discussed in an intensely practical talk by Mr. Phillips, who urged the necessity of adopting every reasonable means to sustain interest in safe equipment and methods of work. He said that during the past year the Wabash car department has operated without the loss of a single life, arm, hand, foot or eye, a wonderful record compared to what used to be considered a good performance not so many years ago. Since the car department employs more men than almost any other single railroad department, safe practices in the rebuilding and maintenance of cars are especially important.

* * *

Wide World Photo

T. M. Davis of San Bruno, Cal., is a painter of locomotives by day in the shops of the Southern Pacific and in his odd hours he paints locomotives on canvas. His paintings adorn the wall of the company's headquarters in San Francisco. Davis calls it his hobby and he has no thought of recompense. He is shown here with one of his paintings

Mr. Phillips asked the car men in attendance at the meeting the following three pertinent questions: "Have you issued necessary instructions for safe operation in the car department? Do you know that these instructions are being carried out? What steps are you taking to see that they are carried out?"

The Business Outlook

Cleveland Railway Club.—Meeting held on April 13 at the Brotherhood of Railroad Trainmen's Auditorium, West Ninth street and Superior avenue, Cleveland, Ohio. Paper by Col. F. W. Green, vice-president, St. Louis-Southwestern on, "The Business Outlook." ¶Col. Green outlined the conditions, caused by the present depression, which must be squarely faced by the railroads if they are to continue giving satisfactory service and earn a reasonable return on their investment. ¶Col. Green's address concluded with the following pertinent remarks. "Railroads work on a very narrow margin between income and outgo. Believe it or not, the welfare of the public is intimately related to the welfare of the railroads. It has been shown that over a long period of years, the curve of general prosperity and the curve of railroad prosperity run parallel. When railroads stop buying, prosperity wanes, and conversely. The reason for this is that the railroads rank at or near the top as consumers of bituminous coal, fuel oil, iron and steel, brass castings, lumber, cement, paints and varnishes, and so on. Prices fluctuate with demand. When the railroad demand stops, prices slump. If you want to help yourself, help the railroads, and if you want to help the railroads to do their part about bringing about a return of prosperity, may I suggest that you do two things: (1) Decline to permit yourself to be misled by fantastic economic theories, such as increasing wages to increase purchasing power, and (2) That you let your congressmen and senators know that you are interested in their helping to bring about return of prosperity and that, in your opinion, a quick way of bringing it about would be to permit trans-continental carriers to compete with ocean carriers operating through the Panama Canal without reduction of rates to all intermediate points to the basis of the ocean terminal rates."

Supply Companies Forego Annual Exhibits

Allied Railway Supply Association.—Meeting held at the Hotel Sherman, Chicago, Monday, May 4. ¶Representatives of the railway equipment manufacturers and supply companies, which usually hold exhibitions in connection with the annual conventions of railroad mechanical department officers and supervisors, discussed the unusual situation presented by the fact that most of the associations have definitely cancelled their annual meetings for the present year, or arranged for brief business sessions with no exhibits. In order to work more effectively with the General Committee of the American Railway Association, Mechanical division, in its plans for simultaneous convention dates and a single exhibition open to all, when next these associations meet, a new organization was formed known as the Allied Railway Supply Association, which consists of a consolidation of the following associations: Railway Equipment Manufacturers' Association (formerly meeting with the Traveling Engineers' Association); Air Brake Appliance Association (formerly meeting with the Air Brake Association); Association of Railway Supply Men (formerly meeting with the International Railway General Foremen's Association); Boiler Makers' Supply Men's Association (formerly meeting with the Master Boiler Makers' Association); International Railway Supply Men's Association (formerly meeting with the International Railway Fuel Association); Master Blacksmiths' Supply Men's Association (formerly meeting with the International Railroad Master Blacksmiths' Association); Supply Men's Association (formerly meeting with the Car Department Officers' Association). ¶The following were elected officers of the Allied Railway Supply Association: President, Irving H. Jones, Irving H. Jones Company, Cleveland, Ohio; first vice-president, Louis B. Rhodes, Vapor Car Heating Company, Washington, D. C.; second vice-president, S. A. Witt, Detroit Lubricator Company, Chicago; third vice-president, J. W. Fogg, MacLean-Fogg Lock Nut Company, Chicago; fourth vice-president, C. F. Weil, American Brake Shoe & Foundry Company, Chicago; fifth vice-president, Arthur S. Lewis, Barco Manufacturing Company, Chicago; sixth vice-president, W. A. Champieux, Oxweld Railroad Service Company, Chicago; secretary, F. W. Venton, Crane Company, Chicago; treasurer, G. R. Voyce, A. M. Castle & Co., Chicago.

Directory

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—T. L. Burton, Room 5605 Grand Central Terminal building, New York.

ALLIED RAILWAY SUPPLY ASSOCIATION.—F. W. Venton, Crane Company, Chicago.

AMERICAN RAILWAY ASSOCIATION.—DIVISION V.—MECHANICAL.—V. R. Hawthorne, 59 East Van Buren street, Chicago. Meeting June 23, 24 and 25, Congress Hotel, Chicago.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey street, New York.

DIVISION I. — SAFETY SECTION. — J. C. Caviston, 30 Vesey street, New York.

DIVISION VIII.—CAR SERVICE DIVISION.—C. A. Buch, Seventeenth and H streets, Washington, D. C.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet avenue, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth street, New York.

RAILROAD DIVISION.—Paul D. Mallay, chief engineer, transportation department, Johns-Manville Corporation, 292 Madison avenue, New York.

MACHINE SHOP PRACTICE DIVISION. — Carlos de Zafra, care of A. S. M. E., 29 West Thirty-ninth street, New York.

MATERIALS HANDLING DIVISION.—M. W. Potts, Alvey-Ferguson Company, 1440 Broadway, New York.

OIL AND GAS POWER DIVISION.—L. H. Morrison, associate editor, Power, 475 Tenth avenue, New York.

FUELS DIVISION.—A. D. Black, associate editor, Power, 475 Tenth avenue, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 7016 Euclid avenue, Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce street, Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth street, New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CAR DEPARTMENT OFFICERS ASSOCIATION.—A. S. Sternberg, master car builder, Belt Railway of Chicago.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 608 South Main street, Los Angeles, Cal. Meetings second Monday of each month except July, August and September, in the Pacific Electric Club building, Los Angeles, Cal.

CAR FOREMAN'S ASSOCIATION OF OMAHA, Council Bluffs and South Omaha Interchange.—Geo. Kriegler, car foreman, Chicago, Burlington & Quincy, Sixteenth avenue and Sixth streets, Council Bluffs, Iowa. Regular meetings, second Thursday of each month at Council Bluffs.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. G. Weigman, 720 North Twenty-third street, East St. Louis, Ill. Regular meeting first Tuesday in each month, except July and August, at American Hotel Annex, St. Louis, Mo.

CLEVELAND RAILWAY CLUB.—F. L. Frericks, 14416 Adler avenue, Cleveland, Ohio. Meeting second Monday each month, except July, August and September, at the Auditorium, Brotherhood of Railroad Trainmen's building, West Ninth and Superior avenue, Cleveland.

INDIANAPOLIS CAR INSPECTION ASSOCIATION.—E. A. Jackson, Box 22, Mail Room, Union Station, Indianapolis, Ind. Regular meetings first Monday of each month at Hotel Severin, Indianapolis, at 7 p.m. Noon-day luncheon 12:15 p.m. for Executive Committee and men interested in the car department.

INTERNATIONAL RAILROAD MASTER BLACKSMITH'S ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark avenue, Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—C. T. Winkless, Room 707, LaSalle Street Station, Chicago. Business session, without exhibit or entertainment, September 15 and 16, Hotel Sherman, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash street, Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, 3730 South Prieur street, New Orleans, La. Meetings third Thursday.

MASTER BOILERMAKER'S ASSOCIATION. — A. F. Stiglmeier, secretary, 29 Parkwood street, Albany, N. Y.

MASTER CAR BUILDERS' AND SUPERVISORS' ASSOCIATION.—See Car Department Officers Association.

NATIONAL SAFETY COUNCIL—STEAM RAILROAD SECTION.—W. A. Booth, Canadian National Montreal, Que. William Penn and Fort Pitt Hotels, Pittsburgh, Pa.

PACIFIC RAILWAY CLUB.—W. S. Wollner, P. O. Box. 3275, San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

PUEBLO CAR MEN'S ASSOCIATION.—I. F. Wharton, chief clerk, Interchange Bureau, Pueblo, Colo.

RAILWAY BUSINESS ASSOCIATION. — Frank W. Noxon, 1124 Woodward building, Washington, D. C.

RAILWAY CAR MEN'S CLUB OF PEORIA AND PEKIN.—C. L. Roberts, chief clerk, Peoria & Pekin Union Railway, 217 Lydia avenue, Peoria, Ill.

RAILWAY FIRE PROTECTION ASSOCIATION.—R. R. Hackett, Baltimore & Ohio, Baltimore, Md.

RAILWAY SUPPLY MANUFACTURERS' ASSOCIATION.—J. D. Conway, 1841 Oliver building, Pittsburgh, Pa. Meets with Mechanical Division and Purchases and Stores Division, American Railway Association.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meetings third Thursday in January, March, May, June, September and November. Annual meeting third Thursday in November, Ansley Hotel, Atlanta, Ga.

SUPPLY MEN'S ASSOCIATION. — E. H. Hancock, treasurer, Louisville Varnish Company, Louisville, Ky. Meets with Equipment Painting Section, Mechanical Division American Railway Association.

TRAVELING ENGINEERS' ASSOCIATION. — W. O. Thompson, 1177 East Ninety-eighth street, Cleveland, Ohio.

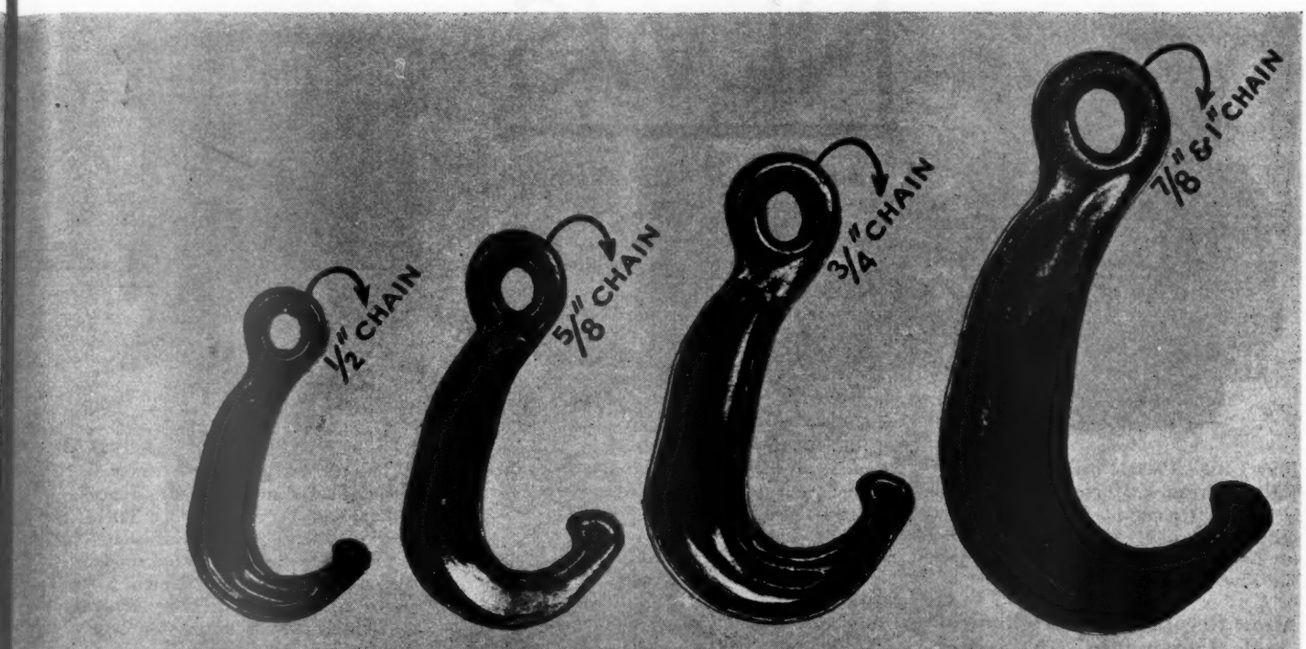
(Continued on second left-hand page)

ALCO
BEMIS HOOK

A GUARANTEED
ALCO PRODUCT

SHAPE OF HOOK
BEFORE TEST

AMERICAN LOCO
30 CHURCH STREET



HOOK NO.	0	1	2	3
RATED LOAD	4000#	6000#	9000#	14000#
LOAD WITHOUT PERMANENT SET	8000#	11000#	16000#	24000#
FINAL TEST LOAD	20500#	35000#	48000#	76000#

A SAFETY HOOK

THE BEMIS HOOK, by reason of its unique design and great strength, stands between security and danger, between long life and early breakdown. It adds safety to every hooking and unhooking operation, protecting men and equipment.

The "barb" at the point of the Bemis Hook prevents accidental unhooking. It aids in hooking on to the load and stays hooked while slack is being taken up. A convenient depression in each side gives the crane-follower a secure hold without endangering the fingers to be caught by the load. It is not easy to carry loads on the point of the Bemis Hook—any opening into which the point will go will permit the load to fall down to the lower part of the hook assuring a firm and safe hold.

The above illustration shows how Bemis Hooks, tested to over 5 times their rated load, showed no signs of breaking and though stretched badly were not deformed enough to drop their load. Ordinary hooks with the sharp point, when distorted to this degree, would have dropped their load.

Bemis Hooks, drop forged from soft steel, will stand up in heavy service, and when heavily overloaded, open up instead of breaking.

To meet the demand for a swivel type hook—the Bemis Hook is made with a straight shank for use on cranes and hoists requiring swivel hooks.

Bemis Hooks have been in service in some of the largest shops and have met with satisfaction every requirement of economy and safety.

MOTIVE COMPANY
NEW YORK CITY

NEWS

THE UNION PACIFIC has awarded a contract to Fairbanks, Morse & Co., Chicago, for the construction of a 450-ton steel locomotive coaling and sanding station, with full automatic skip hoist, at Marysville, Kan.

Alton Recalls 1,100 Mechanical and Maintenance Employees

APPROXIMATELY 1,100 mechanical, maintenance of way and signal department employees of the Chicago & Alton who have been laid off for varying periods have been recalled. About 800 maintenance of way workers resumed work on May 25, and next Monday, 250 shop employees and 50 signal department men will return to work. At the same time shop work will be changed from three-days-a-week to a five-day week basis.

Permanent Transport Exhibition in New York Museum

A PERMANENT EXHIBITION of the development of land and sea transportation comprising exact scale models of ships, trains, wagons, automobiles and other conveyances, together with historic originals and replicas, was opened on May 25 at the Museum of Science and Industry, 220 East Forty-second street, New York City, by Frederic B. Pratt, president of the museum.

The exhibition contains three divisions, devoted to displays of highway, railroad and marine travel respectively. It is a part of a projected series of exhibits which will ultimately portray the significant historical steps in the major fields of man's material evolution. The transportation exhibits were gathered and arranged under the direction of Professor Charles R. Richards, educator and authority on industrial museums, assisted by Carlos de Zafra, of the engineering faculty, New York University; Charles E. Duryea, co-inventor of the Duryea automobile; and Henry O. Havemeyer, Jr.

The history of railroad transportation is presented in a series of chronologically arranged models. Beginning with a model of the "Rocket," the world's first successful locomotive, and the "Tom Thumb," the first locomotive to be built in America, the display includes miniatures of the "Stourbridge Lion," one of the first locomotives used in this country, the "William Crooks," a typical representative of the design introduced in the United States in 1837 and used for the next 55 years, the "Wooten Boiler" locomotive of 1880 whose large grate area, burning fine-sized anthracite centered the attention of the railroad world on boiler development, through to the first electric locomotive of 1895 to be used in trunk line service, a model of the first Mallet type locomotive to be built in this country, a representative of the heaviest type of modern freight locomotives and the latest high pressure multiple expansion locomotive of today which shows a mechanical efficiency of 90.7 per cent.

A feature of the railroad division is an actual size replica of Stevenson's "Rocket," with sections of the working parts cut away to reveal its principles of operation. This replica, complete in details and made by the locomotive company which built the original more than one hundred years ago, is fifteen feet high, seven and one-half feet in length, and weighs approximately 7,000 pounds. It is accompanied by a tender, four feet long, supporting a wooden water barrel.

A series of models is also displayed which show passenger car development, while freight transportation is represented in models of ventilated refrigerator cars, auto freight cars, coal cars, mail cars and others. Included in the railroad division are displays showing the development of the railroad track, railroad signals and roadbed construction. There are also three visitor-operated models of the most important types of locomotive valves and reversing gears, detailing the basis of their working and construction.

P. R. R. Places $16,000,000 Order for Electric Locomotive Apparatus

THE PENNSYLVANIA has placed orders with the Westinghouse Electric & Manufacturing Company and the General Electric Company at an approximate cost of $16,000,000, for the electrical apparatus to be installed in 150 electric passenger and freight locomotives, constituting part of the equipment which will be used when electrification is completed between New York, Philadelphia, Baltimore and Washington.

The Pennsylvania's program also calls for the later purchase of 80 additional electric locomotives of other types. Of the 150 locomotives involved in the present orders, 90 will be for fast through passenger trains and 60 for high speed freight service. The weight of the passenger locomotives will be 375,000 lb. each, and that of the freight locomotives 330,000 lb.

Forthy-three of the new locomotives are to be delivered this year and the remainder before the middle of 1933, when it is anticipated that the electrification work between New York and Washington will be completed. There are now in use on the Pennsylvania System 61 electric locomotives and under construction 96 locomotives which will be increased to 300 by those now authorized and those contemplated for later purchase.

An Air-Conditioned Train

ANTICIPATING the approach of hot weather, a train entirely air-cooled and air-purified has been placed in service on the Baltimore & Ohio for the first time on any railway. The train so air-conditioned is the "Columbian," running between New York, Philadelphia, Baltimore and Washington. All of its equipment, consisting of a smoking lounge car, observation sun-room car, latest type parlor cars, individual seat coaches, and colonial dining car, is equipped with the air-purifying system, both north and south bound.

The apparatus not only regulates the temperature of the air but also controls the humidity and purifies the air, cleansing it of all particles of dust, cinders and smoke. The air is circulated without creating drafts.

The regulation of the temperature is automatically controlled by a thermostat and the apparatus functions both while the train is running and when it is standing still.

Years of experimental work by the mechanical engineers of the Baltimore & Ohio and the Mt. Clare shop forces at Baltimore were required to bring the air-conditioning system into practical use. It was first introduced on the Baltimore & Ohio in a limited way last summer when the railroad successfully air-conditioned one of its diners.

Louisiana & Arkansas Wages

THE EMERGENCY BOARD appointed by President Hoover to deal with the controversy between the Louisiana & Arkansas and its mechanical department employees, which threatened to develop into a strike on April 18, held hearings at Shreveport, La., from April 24 to May 1, and Judge Charles Kerr, chairman of the board who transmitted a report of the

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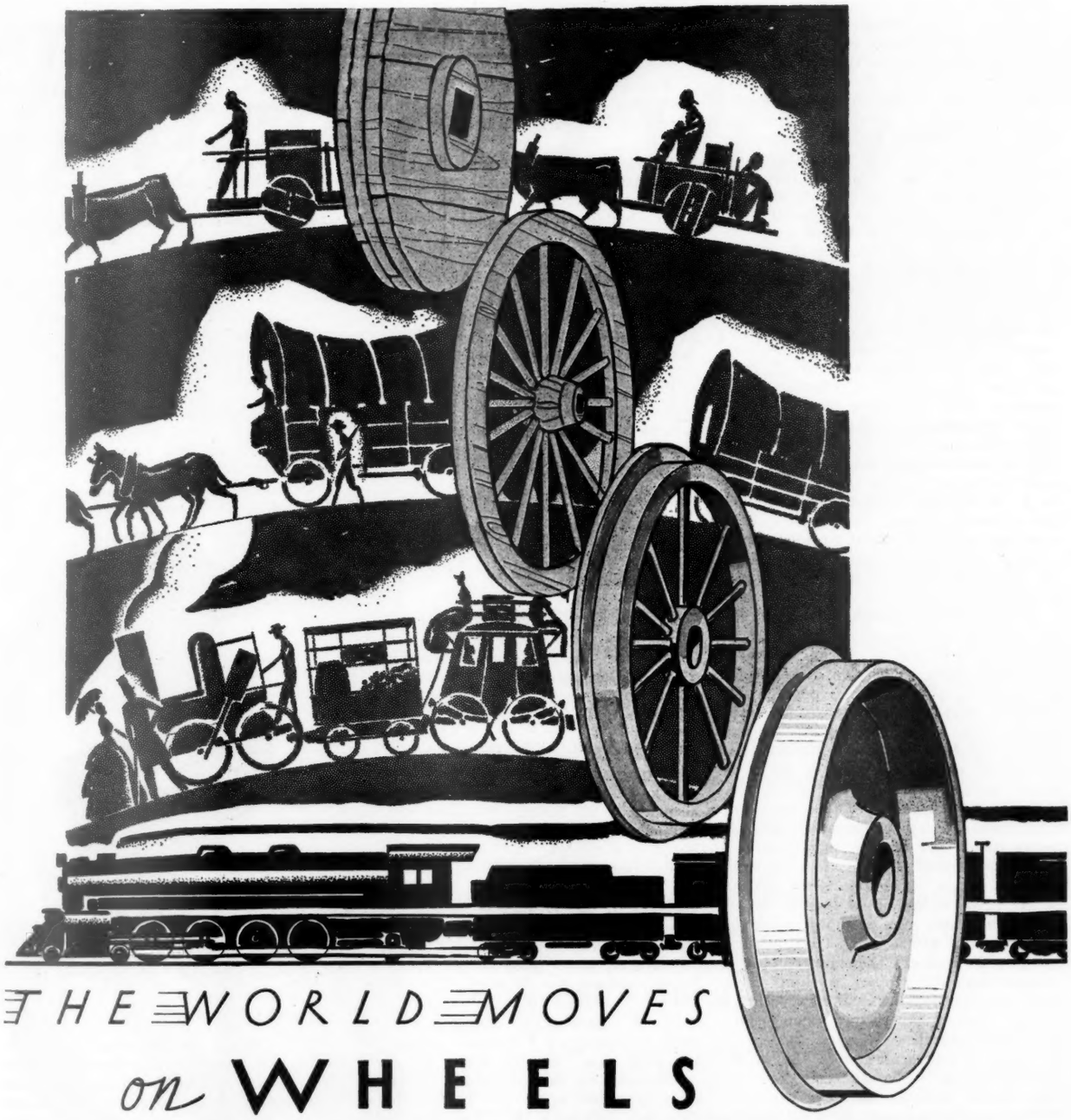

THE WORLD MOVES on WHEELS

FROM the time man discovered that a rounded object rolls with comparative ease and devised the first crude cart, he has ever been on the move. His means of conveyance have undergone vast changes. The slow joggle of the oxcart has given place to the swift flight of the express train, but never has the wheel been supplanted as the basic factor of transportation. Instead, it has become more vitally important than ever. The speed and weight of modern transportation throw a tremendous responsibility on wheels. Significant then is the fact that Carnegie Wrought Steel Wheels are considered the standard of excellence in today's exacting service. To serve even more efficiently, we are now prepared to furnish Rim-Toughened Wrought Steel Wheels. The process of heat treatment to which these wheels are subjected insures additional service out of all proportion to the small increase in cost. Our wheel engineers will be glad to discuss this matter with you further.

CARNEGIE WROUGHT STEEL WHEELS

Product of Carnegie Steel Company, Pittsburgh, Pa. U·S STEEL *Subsidiary of United States Steel Corporation* 119

controversy to the President on May 16. Contrary to the usual practice in such cases, it was not made public. Instead, it was announced at the White House that the management of the road had been asked to come to Washington for further conference with the Board of Mediation in an effort to bring about an adjustment. The law provides that for 30 days after such a board has made its report no change, except by agreement, shall be made by the parties to the controversy in the conditions of the dispute.

The railroad on February 9 ordered a new wage scale and altered working rules for its shop craftsmen, A. L. Burford, of Wilkinson, Lewis, Wilkinson & Burford, general counsel for the L. & A., stated at the opening session of the hearing. The new wage scale of 75 cents an hour represented a reduction of 5 cents an hour. It is the same rate paid prior to August 1, 1929, and 5 cents an hour more than was paid to shop craftsmen on the Louisiana Railway & Navigation Co. before it was purchased by the L. & A. in 1929. Consolidation of the two railroads resulted on August 1, 1929, in a base scale of 80 cents an hour, representing a 10-cent increase for L. R. & N. employees and a 5-cent increase for L. & A. employees.

Adverse business conditions in 1930 led the railroad to suggest a wage cut of 5 cents an hour and a revision of working rules. Other employees of the L. & A., including all officers, have been subjected to a 12½ per cent reduction in salaries. The wage cuts were made necessary by the 1930 business depression, depletion of standing timber in the area served by the railroad, loss of oil tonnage due to competition of pipe lines, and curtailment of other revenues through motor coach and truck competition and crop shortages.

C. P. Couch, executive vice-president of the L. & A., estimated that the wage cut would result in a monthly saving to the railroad of $2,000. H. J. Carr, general vice-president of the Machinists' Union, charged that the revised working rules tend to "break down the apprentice system, give inexperienced men equal pay with experienced men and deny the right of representation of the workmen's choosing." He said that the new rules denied seniority to those who left railroad service to engage in union work.

Supply Trade Notes

THE ROYAL RAILWAY SUPPLY COMPANY, INC., has moved its office from 90 West street to 250 Park avenue, New York.

C. E. NAYLOR, manufacturers' agent, specializing in railway and refinery supplies, has moved his office from the Esperson building to 1400 Conti street, Houston, Tex.

WILLIAM L. HARTLEY has been appointed district sales manager with headquarters at 5938 Linsdale avenue, Detroit, Mich., in charge of Detroit territory for the Link-Belt Company, Chicago.

J. H. MORRIS, assistant secretary and assistant treasurer of the Inland Steel Company, has been promoted to secretary. W. D. Truesdale, secretary and treasurer, will continue as treasurer.

THE PYLE-NATIONAL COMPANY'S office now located in Washington, D. C., has been transferred to the Baltimore Trust building, Baltimore, Md. J. L. Reese will be in charge.

A. J. COUSE has been appointed district manager of the Chicago territory for the Edgewater Steel Company, Pittsburgh, Pa. Mr. Couse will have his headquarters as heretofore, in the Peoples Gas building, Chicago.

J. L. VAUCLAIN, vice-president and manager of the Baldwin Locomotive Works, Eddystone, Pa., has resigned on account of ill health. He is a son of Samuel M. Vauclain, chairman of the board of directors.

J. C. MCQUISTON, general advertising manager of the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has retired. Mr. McQuiston had been in charge of advertising for the Westinghouse company for 29 years.

M. B. MACNEILLE, manager of the pump division of Fairbanks, Morse & Company, has resigned after 19 years connection with that company, to join the sales organization of the Dayton-Dowd Company, Quincy, Ill. Mr. MacNeille will act as western sales manager with headquarters at San Francisco, Cal.

ALVAH H. WARREN, JR., assistant manager of sales of the Illinois Steel Company, Chicago, with headquarters at St. Paul, Minn., has been promoted to manager of sales to succeed W. J. Totten, retired.

THE DARDELET THREADLOCK CORPORATION, New York, has granted licenses to the Colorado Fuel & Iron Company, for the manufacture and sale of track and commercial bolts and nuts formed with the Dardelet self-locking thread.

THE SUPERIOR RAILWAY PRODUCTS CORPORATION, a newly organized company, with offices at 7501 Thomas Boulevard, Pittsburgh, Pa., has taken over the manufacture and marketing of the railway products formerly manufactured by

W. R. Gellatly

the Rees Manufacturing Company, Pittsburgh. William R. Gellatly, formerly vice-president of the Rees Manufacturing Company, is president of the new organization.

R. F. MEHL, superintendent of the division of physical metallurgy of the Naval Research Laboratory has been appointed assistant director of research of the American Rolling Mill Company, Middletown, Ohio. He will take charge on September 1 of the physical science department of the Armco laboratories.

J. E. BUCKINGHAM has been appointed western regional manager of the railroad division of the Worthington Pump & Machinery Corporation, with headquarters at Chicago, succeeding J. M. Lammedee, resigned. Mr. Buckingham was formerly located at Harrison, N. J.

THE GRINDLE FUEL EQUIPMENT COMPANY, Harvey, Ill, a subsidiary of the Whiting Corporation, has purchased the exclusive manufacturing and selling rights to the Bethlehem pulverizer formerly manufactured by the Bethlehem Steel Company.

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Domestic Orders Reported During May, 1931

Locomotives

Name of Company	Number ordered	Type	Builder
Lehigh & New England	1	Switching	Baldwin Locomotive Wks.
Pennsylvania	150	Electric	Westinghouse Elec. & Manufacturing Co. and General Electric Co.
Total for Month of May	151		

Freight Cars

Name of Company	Number ordered	Type	Builder
Union Tank Car Company	15	Tank	American Car & Foundry Company
Erie	1	Dump	Koppel Industrial Car & Equipment Co.
Chicago, Milwaukee, St. Paul & Pacific	4	Dump	Western Wheeled Scraper Company
Union Pacific	6	Dump	Differential Steel Car Company.
United Verde Copper Company	4	Dump	Western Wheeled Scraper Company
Board of Transportation, City of New York	16	Service	Magor Car Corporation
Total for Month of May	46		

There is a way—

to protect railway piping from atmospheric corrosion

IN the railway field, as elsewhere, the superior durability of Copper-Steel Pipe in exposure to the elements has been proved beyond question.

Railway uses for Copper-Steel Pipe are many and varied because of the severe corrosive conditions to which most railway equipment is subject. And wherever Copper-Steel Pipe has been tried, for resistance to atmospheric corrosion, the savings accomplished have far outweighed the small extra investment.

For all piping on locomotives and cars, for signal piping, tubular poles, or any use in which pipe encounters alternate wet and dry exposure, this extra durable pipe is recommended. May we send you printed matter? Ask for Bulletin 11, describing NATIONAL Copper-Steel Pipe—

The Original Copper-Steel Pipe

NATIONAL TUBE COMPANY · Pittsburgh, Pa.
Subsidiary of United States Steel Corporation

H. T. BENNETT, assistant manager of sales of the American Sheet & Tin Plate Company, Pittsburgh, Pa., with headquarters at Chicago, has been promoted to manager of sales, with the same headquarters, to succeed W. H. Eaton, who retired on May 1, and has been succeeded by A. P. Bronson, representative at Chicago.

WILLIAM THOMPSON, assistant to the president of the American Steel & Wire Company, Cleveland, Ohio, retired on May 1. George F. Rummel, for the past two years assigned to special work and during the previous 26 years assistant general manager of sales, also retired.

J. E. GARDINER, formerly general air brake inspector of the Boston & Maine and since July, 1930, a sales representative of the Gustin-Bacon Manufacturing Company at Philadelphia, Pa., has been appointed special representative of the Schaefer Equipment Company, with head-

J. E. Gardiner

quarters at Pittsburgh, Pa. Mr. Gardiner has been an active member of the Air Brake Association for many years and was for a time a member of its executive committee.

AT A RECENT MEETING of the board of directors of the General Refractories Company, Philadelphia, Pa., Burrows Sloan was elected chairman of the board, John R. Sproul was elected president, E. A. McKelvy was elected vice-president and Roger A. Hitchins was elected secretary and treasurer. All of the other officers of the company were reappointed. In addition to being president and a director of the General Refractories Company, John R. Sproul is a director of the Lehigh Valley, the Philadelphia, Baltimore & Washington and vice-president and director of the Lackawanna & Wyoming Valley.

J R. CROCKER, for a number of years district manager of the Permutit Company, New York, who has been associated with the company since 1913, has been appointed special western railroad representative, with headquarters at 215 Pershing Road, Kansas City, Mo., and W. R. Toppan has been appointed special eastern railroad representative, with office at 332 South Michigan avenue, Chicago.

FANSTEEL PRODUCTS COMPANY, INC., North Chicago, Ill., has organized a subsidiary, the Ramet Corporation of America, to take over the United States and Canadian rights for hard cutting metals developed by the former company. The officers of the new company are: President, J. M. Troxel, chairman of the board of Fansteel; vice-president and general manager, C. E. Stryker, manager of Balkite sales of Fansteel; and secretary and treasurer, E. F. Radke, secretary and treasurer of Fansteel.

JOHN THOMAS, general sales manager of the McIntosh & Seymour Corporation, Auburn, N. Y., has been appointed vice-president in charge of sales, with

John Thomas

the same headquarters. Mr. Thomas was born in Alabama and is a graduate engineer. He served for ten years with the General Electric Company during the latter part of which he was in charge of the marine section. Mr. Thomas was appointed general sales manager of the McIntosh & Seymour Corporation in October, 1930.

J. K. AIMER has been appointed assistant general manager of sales of the Reading Iron Company, with office at 230 Park avenue, New York. W. S. Shiffer has been appointed assistant to general manager of sales, and R. I. Fretz has been transferred from the Reading district and is in charge as district sales representative of the Pittsburgh district in place of Wyman Howells, who now directs the activities of the Reading district; Harry L. Bialock is associated with the St. Louis district under the direction of J. L. Jacobson, district sales representative; L. C. Hartzell, under the direction of R. W. Thompson, Reading, Pa., is engaged in the promotion of the nipple business; George D. Smith, has been appointed railroad salesman under the direction of Mr. Aimer, and E. S. Moorehead has been assigned to the Pittsburgh district under the direction of Mr. Fretz.

J. S. TRITLE, vice-president in charge of manufacturing of the Westinghouse Electric & Manufacturing Company, has been elected vice-president and general manager in charge of manufacturing, sales and engineering operations of the company, reporting to President F. A. Merrick, with headquarters as heretofore at East Pittsburgh, Pa. Mr. Tritle was born at Virginia City, Nev., in 1872 and was graduated from Yale University in 1893 with a degree in science. In 1895 he entered the electrical engineering contracting business, in which he continued for eight years. At the outset of the St. Louis World's Fair, he served as chief of construction and at the close of the fair, he was made manager of the Kansas City district for the Westinghouse Company. In 1915 the St. Louis and Kansas City offices were consolidated and Mr. Tritle assumed charge of both. In 1922 he was made manager of the merchandising department, a division of the general sales department of the company. In 1925, when a separate department was made of the merchandising business, Mr. Tritle

J. S. Tritle

was made general manager of the merchandising department, with headquarters at Mansfield, Ohio, overseeing engineering and manufacturing as well as sales work of that department. On May 1, 1929, he was appointed vice-president in charge of manufacturing operations, with headquarters at East Pittsburgh.

JOHN M. LESSELS, formerly manager of the mechanics division of the Westinghouse research laboratories, has been appointed manager of engineering at the South Philadelphia works of the Westinghouse Electric & Manufacturing Company. Mr. Lessels was born at Dunfermline, Scotland, in 1888. He attended Heriot-Watt College, Edinburgh, the University of Edinburgh and the University of Glasgow, graduating from the latter institution in 1915 with the degree of bachelor of science in engineering, both mechanical and electrical. He was Lauder-Carnegie scholar at Glasgow in 1911. He later held positions as aero-engine inspector for the British war office, as assistant manager of the aero-engine department of Armstrong-Whitworth, Newcastle-on-Tyne, and as special engineer to works manager in charge of all sub-contractors for Rolls Royce. He entered the Westinghouse organization in February, 1920, and served six months in the office of the chief mechanical engineer. He then was appointed mechanical engineer in the railway department, which position he left in May, 1922, to

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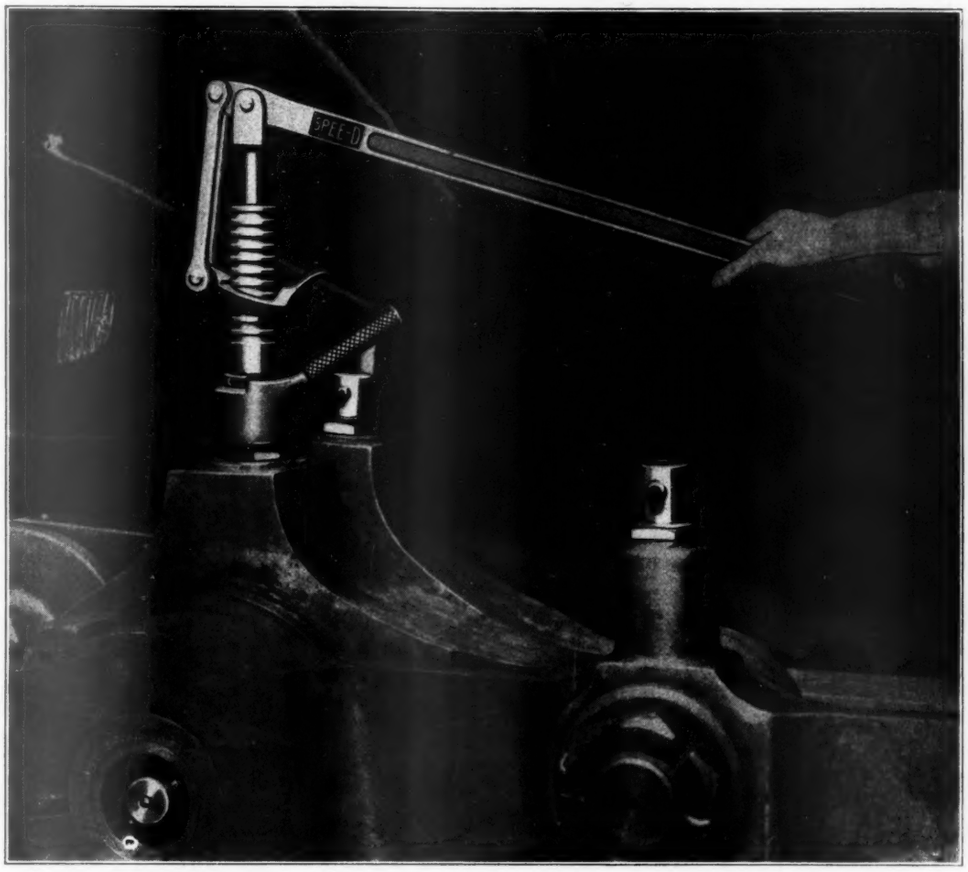

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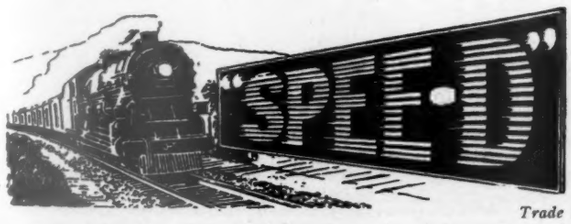

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enter the research department. He is an active member of several engineering societies and technical organizations in this country and aboard, and is secretary

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J. M. Lessells

of the executive committee of the Applied Mechanics Division of the American Society of Mechanical Engineers.

Baldwin Acquires Cramp-Morris Properties

THE BALDWIN LOCOMOTIVE WORKS has purchased the subsidiaries of Cramp-Morris Industrial, Inc., which include I. P. Morris & De La Vergne, Inc.; De La Vergne Engine Company; Cramp Brass & Iron Foundries Company, all of Philadelphia, Pa.; the Federal Steel Foundry Company of Chester, Pa., and the Pelton Water Wheel Company of San Francisco, Cal.

While plans for the disposition of the newly acquired properties have not yet been completed, a gradual absorption is contemplated and, where practicable, it is anticipated that machinery and assets will be removed to the Eddystone, Pa., plant, from which point all activities in the future will be directed.

With the transfer of its subsidiaries to Baldwin, the Cramp-Morris Company has divested itself of its major assets. The old William Cramp & Sons shipyard is not included in the deal and that property will continue in the process of liquidation. Prior to 1927 the companies just acquired by Baldwin were either subsidiaries or non-marine departments of the William Cramp & Sons Ship & Engine Building Company. In 1926 when the latter company decided to discontinue the building of ships, the subsidiaries and departments were placed under a holding company, Cramp-Morris Industrials, Inc.

H. Birchard Taylor, president of the Cramp-Morris Properties, is expected to join the Baldwin group, and policies of conducting research and experimental work followed in the development of Cramp-Morris products will be carried on with increased facilities under Baldwin management.

I. P. Morris & De La Vergne, Inc., manufacturers of hydraulic turbine machinery, represents a consolidation of the I. P. Morris Company and the De La Vergne Machine Company, formerly of New York, but recently moved to Philadelphia and consolidated with the operations of the I. P. Morris Company. The De La Vergne Machine Company for many years designed and constructed refrigerating machinery and was one of the first concerns in the United States to develop Diesel engines. The Pelton Water Wheel Company designs and constructs hydraulic turbine machinery and valves; the Federal Steel Foundry Company specializes in high-grade commercial steel castings, and the Cramp Brass & Iron Foundries Company operates a cupola iron foundry, an electric iron foundry and one of the largest brass foundries in the United States.

Obituary

HARRINGTON EMERSON, consulting engineer, writer and educator, died at New York on May 23 at the age of 77. Mr. Emerson was born at Trenton, N. J., on August 2, 1853. He attended the Royal Bavarian Polytechnic in Germany from 1872 to 1875 and during the year 1875-76 attended universities in Italy and Greece. From 1876 to 1882 he was professor of modern languages at the University of Nebraska, and for the next four years was engaged in banking and land business. From 1896 to 1898 he examined many industrial plants and mines in the United States, Mexico and Canada as a United States representative of a British syndicate. From 1900 to 1923 he was president of Emerson Engi-

Harrington Emerson

neers, efficiency engineers, and during the years 1898-1901 he put into operation some of the first long distance mail routes in Alaska and down the Yukon. He reported on all the known coal deposits of the North American western coast and also on the northern submarine cable route to Asia, the latter report being largely followed by the War Department in laying its Alaskan cables. He gained recognition through results obtained by efficiency methods installed on the Atchison, Topeka & Santa Fe and was the author of "Efficiency as the Basis for Operation and Wages," published in 1909; "The Twelve Principles of Efficiency"; "Colonel Schoonmaker and the Pittsburgh & Lake Erie Railroad," and "Lessons in Personal Efficiency." In 1921 Mr. Emerson was appointed a member of the Committee for Elimination of Waste in Industry of the Federated American Engineering Societies, the committee, headed by Herbert Hoover, having been assigned to investigate and report on railroads and bituminous coal mining. He was a member of the American Society of Mechanical Engineers; Societe des Ingenieurs Civils de France (president American Section); Mechanical and Purchases and Stores Divisions, A. R. A.; American Economic Association; American Association of Labor Legislation; American Electrochemical Society; American Institute of Metals; Illuminating Engineering Society; American Electric Railway Association; Franklin Institute, etc.

WILSON E. SYMONS, consulting engineer, died on May 1 at the Elks Club, New York City, where he had resided for some time. Mr. Symons was born on December 18, 1858, at Farmland, Ind., and was educated at Dublin Academy in eastern Indiana. He began railway work in 1880 as a machinist at the Chicago shops of the Chicago, Rock Island & Pacific. From 1881 to 1885 he was chief engineer in the merchant marine service on the Great Lakes and then to 1887 was consecutively locomotive fireman and engineman, and engaged in special engineering work on the Wisconsin Central. He subsequently served as locomotive engineman on the Atlantic & Pacific, now part of the Atchison, Topeka & Santa Fe, and in special engineering work in California and Arizona until 1889 when he went to the Electric Engineering Works, Chicago. The following year he was appointed general foreman of the Atchison, Topeka & Santa Fe, at Chanute, Kan., subsequently serving as master mechanic on the same road first at Arkansas City, Kan., then at Raton, N. M., and later on the Mexican Central, at San Luis Potosi, Mex. From 1896 to 1898 he was mechanical expert and salesman of the Galina Oil Company, in the United States, England and France. He then was appointed superintendent of motive power and equipment at Savannah, Ga., on the Plant System, now a part of the Atlantic Coast Line, and from May, 1902, until August, 1904, was mechanical superintendent of the Gulf, Colorado & Santa Fe. From August, 1904, until the following June, he was with the Kansas City Southern as superintendent of machinery and later was engaged in special consulting work at Chicago. In 1909 he was appointed superintendent of motive power and machinery of the Chicago Great Western, at St. Paul, Minn., returning to special railway consulting work in 1910 at Chicago. He served from December, 1912, for about eight months as superintendent of motive power of the San Antonio & Aransas Pass. From 1914 to 1919 Mr. Symons was a vice-president of the Wilson Welder & Metals Company, New York, and since that time had been engaged as an editorial writer and a consulting engineer, specializing in railway engineering work.

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Personal Mention

General

THE TITLE OF Hugh Ronalds, master mechanic of the Lehigh & New England, with headquarters at Pen Argyl, Pa., has been changed to superintendent of motive power.

H. W. REINHARDT, assistant superintendent of motive power of the Chicago Great Western, has been promoted to superintendent of motive power, with headquarters as before at Oelwein, Iowa, succeeding E. J. Brennan, who retired from active service on May 1.

JOHN HORRIGAN, who retired on May 1 as superintendent of motive power of the Elgin, Joliet & Eastern, with headquarters at Joliet, Ill., has been connected with that railroad for more than 36 years, 32 of which were as superintendent of motive power. He was born at Mendota, Ill., on June 23, 1860, and attended the public schools at Marshalltown, Iowa. He entered railroad service in 1877 as a machinist apprentice on the Iowa Central (now part of the Minneapolis & St. Louis). Later he was advanced successively through the positions of machinist, enginehouse foreman

J. Horrigan

and division master mechanic at Keithsburg, Ill. On May 1, 1893, Mr. Horrigan became enginehouse foreman of the Chicago, Rock Island & Pacific at Blue Island, Ill., and in the following year he was appointed master mechanic on the Elgin, Joliet & Eastern at Joliet. He was promoted to superintendent of motive power on May 15, 1899, in which position he remained continuously until his retirement.

W. D. ROBB, vice-president of the Canadian National in charge of telegraphs, colonization, natural resources, radio, insurance, etc., will retire on June 30, after the completion of 60 years of active service. Upon his retirement the vice-presidency occupied by Mr. Robb will be abolished, and the various departments of which he has charge will be allocated to the jurisdiction of other officers in the National System. Mr. Robb was born on September 23, 1857, at Longueuil, Que., and was educated at Sherbrooke Academy, Sherbrooke, Que., and Richmond College, Richmond, Que. He began his railroad career in July, 1871, as an apprentice in the motive power department of the Grand Trunk (now part of the C. N. R.), and in May, 1874, was transferred to Montreal, completing his apprenticeship at that point. In February, 1883, he be-

W. D. Robb

came night locomotive foreman serving in that capacity first at Port St. Charles, and later at Belleville, Ont. In January, 1897, he was appointed master mechanic at London, Ont., and nine months later was assigned a similar position at Toronto, Ont. In 1901, Mr. Robb was appointed acting superintendent of motive power at Montreal, and in the following year became superintendent of motive power. In 1917, he was appointed vice-president in charge of the motive power and car departments; in 1918, became operating vice-president of the system; in 1922, vice-president and general manager, and, in February, 1923, was appointed to the position of vice-president.

Master Mechanics and Road Foremen

W. C. DAVIS has been appointed road foreman of engines of the Southern Pacific, Pacific Lines, with headquarters at Dunsmuir, Cal.

THE JURISDICTION of F. P. Nash, master mechanic of the Burnside shops, has been extended to include the Chicago terminal.

D. W. SAUNDERS, master mechanic of the Chicago terminal of the Illinois Central, has been transferred to Vicksburg, Miss., succeeding S. R. Mauldin.

THE JURISDICTION of H. L. Needham, general master mechanic on the Illinois Central at Chicago, has been extended to include the Burnside shops at Chicago.

G. C. HESS, assistant road foreman of engines of the Cumberland Valley division of the Pennsylvania, has been promoted to the position of assistant road foreman of engines of the Middle division.

R. C. MCINTYRE has been appointed master mechanic of the Union Railroad, succeeding Charles R. Church, retired. Mr. McIntyre's headquarters will be at East Pittsburgh, Pa.

A. H. HOFFMAN, assistant general air brake inspector and district road foreman of engines of the Southern Pacific, with headquarters at Los Angeles, Cal., has been appointed road foreman of engines of the San Joaquin division, with headquarters at Bakersfield, Cal.

Car Department

D. J. PASKEY, car foreman of the Central of New Jersey at Penobscot, Pa., has been appointed general car foreman, with headquarters at Allentown, Pa.

Shops and Enginehouse

W. E. MULLEN has been appointed general foreman of the Pennsylvania, with headquarters at Northumberland, Pa.

S. R. MAULDIN, master mechanic of the Illinois Central at Vicksburg, Miss., has been appointed general foreman, locomotive department, at Vicksburg.

W. U. DIXON, general foreman of the Delmarva division of the Pennsylvania, has been promoted to the position of assistant supervisor of the Williamsport division, with headquarters at Millersburg, Pa.

Purchasing and Stores

J. R. UMMEL, office manager of the Alaska Railroad, with headquarters at Seattle, Wash., has been appointed also purchasing agent.

C. S. JONES, division storekeeper of Stockton division of the Southern Pacific at Tracy, Cal., has been transferred to the Shasta division at Dunsmuir, Cal.

C. J. PEARCE, division storekeeper of the Shasta division of the Southern Pacific at Dunsmuir, Cal., has been transferred to the Western division, with headquarters at Oakland Pier, Cal.

H. J. VANCE, purchasing agent of the Chicago & Illinois Valley, with headquarters at Granite City, Ill., has been appointed chief purchasing officer of the Illinois Terminal System, with headquarters at Chicago.

Obituary

C. V. COULTER, formerly district storekeeper of the Cleveland, Cincinnati, Chicago & St. Louis, died at his home in Indianapolis, Ind., May 12, after a short illness.

LESLIE G. PEARSON, district storekeeper on the Southern Pacific at El Paso, Tex., died in that city on May 7 from injuries received when he was struck by a broken emery wheel on a portable electric grinder.